SOUTHWEST COASTAL LOUISIANA
REVISED INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex G

U.S. Fish and Wildlife Service Revised Draft Coordination Act Report

Southwest Coastal Louisiana Feasibility Study

REVISED DRAFT

FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO

NEW ORLEANS DISTRICT

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

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LAFAYETTE, LOUISIANA

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (Corps) was requested to conduct the Southwest Coastal Louisiana Feasibility Study (SWLA Study) via Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 10 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."

Numerous measures to provide storm damage reduction and ecosystem restoration measures were evaluated within the study area. Those measures included construction of levees designed to provide hurricane storm surge protection (including the armored 12-foot levee described above), protection and restoration of coastal wetlands and unique natural ecosystem features (such as cheniers), construction of shoreline protection projects (for navigation canals, interior lakes and bays, and the Gulf of Mexico), and implementation of non-structural protection measures such as structure relocations and buyouts.

The initial list of proposed project measures was derived from existing large-scale coastal protection and ecosystem restoration plans (e.g., the Louisiana Coastal Protection and Restoration Plan [LACPR], the Louisiana Coastal Area Ecosystem Restoration Study Report [LCA], and the Louisiana's Comprehensive Master Plan for a Sustainable Coast [State Master Plan 2012]). Public comments were received during the project scoping process, and recommendations provided by local representatives and natural resource agencies during the initial planning phase of the project. The initial list of potential project measures was reduced to a more focused and achievable final list of measures based on criteria that were approved by an interagency project delivery team.

The final list of measures was assembled into 6 possible protection levee alternatives and 6 ecosystem restoration alternatives, all of which were evaluated for cost effectiveness. Of the flood protection features, only the non-structural protection measures in select locations were cost effective and included in the Tentatively Selected Plan (TSP). Restoration Alternative 4 (Entry Salinity Control Alternative) was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass and Calcasieu Ship Channel salinity control structures (measures 48 and 7, respectively), and to add the shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6b1, 6b2, and 6b3).

In addition to providing hurricane storm surge protection in developed portions of the project area, implementation of the TSP would restore, enhance, and protect substantial areas of coastal marsh and forested chenier habitat. However, implementation of some restoration measures could result

in some minor adverse impacts. The recommendations provided below address ways to avoid such unintended impacts and to improve fish and wildlife habitat quality in restoration areas. Therefore, the Service supports implementation of the TSP provided the following recommendations are included as part of the plan.

1. To the greatest degree practical, borrow pits for construction of marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Borrow pit construction should also avoid the following:
    a. avoid inducing wave refraction/diffraction erosion of existing shorelines
    b. avoid inducing slope failure of existing shorelines
    c. avoid submerged aquatic vegetation
    d. avoid increased saltwater intrusion
    e. avoid excessive disturbance to area water bottoms
    f. avoid inducing hypoxia

2. Marsh creation measures should avoid, to the degree practical, areas of dense submerged aquatic vegetation.

3. The Corps should monitor ecosystem restoration features to document the degree of success achieved. We recommend the Service and other interested natural resource agencies be included in developing those monitoring criteria and in the review of subsequent monitoring information and reports.

4. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

5. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex. We recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

6. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

7. We recommend the Corps continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, threatened or endangered species, or species that may be listed in the future.

8. We recommend the Corps coordinate with the Service and other interested natural resource agencies when developing detailed plans regarding restoration measures, especially during the Preliminary Engineering and Design Phase (PED) and construction phase, for measures where specific recommendations have been provided below.

9. To the greatest degree possible, sediment pumping should be conducted during non-growing season periods to reduce possible salinity impacts on adjoining vegetation.

Service recommendations regarding specific ecosystem restoration measures are provided below:

10. Marsh creation measures south of Grand Chenier (47a1, 47a2, and 47c1)
    a. Combined, these measures would convert over 2,000 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries, waterfowl, and other wildlife.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.
    c. To pump into eastern and western extremes of the designated fill area, the pipeline route should depart from that designated route only within the proposed fill area, and should be routed through unvegetated open water areas, to avoid impacting existing marshes.

11. Marsh creation along Freshwater Bayou Canal (measures 127c3 and 306a1)
    a. To avoid saltwater effluent impacts, we recommend the effluent be drained toward Freshwater Bayou Canal and not into the interior marshes. After construction, once saltwater drainage from the fill areas has been completed, those drainage routes should be plugged and drainage of the fill areas should be redirected into interior marshes.
    b. If a containment dike is constructed adjacent to the Freshwater Bayou Canal, the Service recommends that it not be degraded after construction so that it can help to maintain the desired hydrologic isolation of the interior marshes from the canal.

12. Marsh creation near Mud Lake (measure 124c)
    a. This measure would convert over 1,900 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries and waterfowl.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.

c. The proposed containment dikes along the western and southeastern fill area boundaries may block existing drainage routes for marshes adjacent to the fill area. To avoid potential saltwater entrapment impacts and impaired drainage impacts, we recommend weir boxes along those sections of dike be eliminated unless the presence of unimpeded drainage routes can be documented.

13. Marsh creation near West Cove (measure 124d)
    a. To prevent ponding impacts and saltwater entrapment impacts to marshes south of the fill area, we recommend the containment dike designs avoid closing both canals that provide drainage for the fill area and adjacent marshes.

14. Cameron-Creole Spillway (measure74a)

    The Service recommends that an independent feasibility assessment of this feature be conducted and that the design should include lower invert elevations and provide greater operational flexibility than that described under this study. Such a design may also provide more benefits if it could be used to discharge excess water when stages are less than +2.0 feet NAVD1988.

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INTRODUCTION

The Southwest Coastal Louisiana Feasibility Study (SWLA Study) was authorized by Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 10 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway." Investigation of area ecosystem restoration measures was authorized via the Water Resources Development Act of 2007 (Title VII, Louisiana Coastal Area program, Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study).

The study area is located within Louisiana's Chenier Plain which is characterized by lakes, bayous, wetlands, cheniers, and coastal beaches. The Mermentau Basin and the Calcasieu/Sabine Basin are the two major hydrologic basins within the Chenier Plain. There are numerous communities within the study area including Abbeville, Cameron, Delcambre, Erath, Gueydan, Hackberry, Kaplan, Lake Arthur, Lake Charles, and Sulphur. Although the approved Southwest Coastal Louisiana Feasibility Study authorization is restricted to Calcasieu, Cameron, and Vermilion Parishes, several project alternatives occurring beyond those parishes were considered because of their anticipated effects on the project area.

Numerous project measures and groups of measures were evaluated. Surge protection alternatives included alternative levee alignments (including the armored 12-foot levee described above), as well as non-structural alternatives. Ecosystem restoration alternatives included various combinations of salinity control/reduction measures, strategic marsh creation measures, strategically located shoreline protection measures, and restoration/reforestation of cheniers.

This report provides an analysis of the impacts of the Tentatively Selected Plan (TSP) on fish and wildlife resources. The TSP is a combination of non-structural storm surge protection measures, and an array of different types of ecosystem restoration features. The proposed non-structural measures may include earthen berms (3 – 7 feet high) around individual structures. Where structures are located adjacent to wetlands, sheet pile structures will be constructed in lieu of earthen berms to avoid possible wetland impacts associated with berm construction.

The Fish and Wildlife Service (Service) has reviewed available information regarding construction of the proposed ecosystem restoration measures. Our comments, provided herein, are intended to assist the U.S. Army Corps of Engineers (Corps) in avoiding adverse impacts to adjoining marshes that could occur due to construction of the proposed restoration measures.

This draft report is submitted in partial fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This report has been provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service for their review and comment. Their comments will be incorporated into our Final Coordination Act Report.

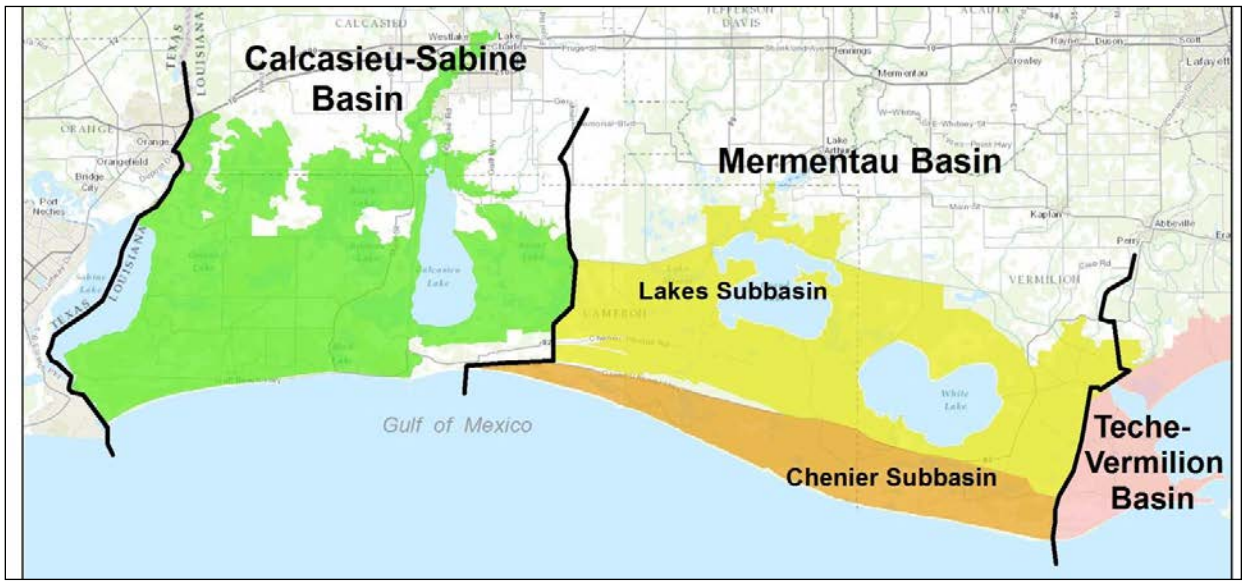
DESCRIPTION OF STUDY AREA

The study area, which encompasses Calcasieu, Cameron, and Vermilion Parishes, is typically termed the Chenier Plain of Louisiana. The Chenier Plain encompasses the southwestern Louisiana coastal zone from Freshwater Bayou west of Vermilion Bay to Sabine Lake on the Texas-Louisiana border. Cheniers are relict beach ridges that generally parallel the Gulf shoreline, and derive their name from the Cajun word "chene" meaning oak, because oaks are the dominant tree species on the crests of the higher chenier ridges (Penland et al. 1989). Because chenier elevations are higher than the surrounding marshes, they often serve as hydrologic barriers, with varying levels of effectiveness, between saline marshes to the south and freshwater marshes to the north (U.S. Army Corps of Engineers 2008). The two hydrologic basins encompassed by the study area are the Mermentau and the Calcasieu-Sabine Basins (Figure 1).

Mermentau Basin

The Mermentau River Basin is located between Freshwater Bayou Canal to the east and that segment of Louisiana Highway 27 east of Calcasieu Lake. The Basin encompasses an area of about 4.2 million acres and contains productive agricultural lands and a variety of natural environments (U.S. Army Corps of Engineers 1999). Coastal wetlands within the Mermentau Basin are divided into two sub-basins, the Lakes and Chenier Sub-basins (Figure 1), both of

Figure 1. Coastal marshes within the coastal Calcasieu-Sabine and Mermentau Basins.



which occur within the feasibility study boundary. North of the Lakes Sub-basin are uplands beyond the study boundary that cover an area of 3,683 square miles of predominantly agricultural land (Gammill et al. 2002). The principal agricultural products in this region are rice and crawfish, which both require ample supplies of fresh water typically provided via the Corps' management of the Mermentau Basin Project (U.S. Army Corps of Engineers 1999).

The Lakes Sub-basin is located roughly between the Gulf Intracoastal Waterway (GIWW) and Louisiana Highway 82, and historically functioned as a low-salinity brackish estuary (Corps 2008).

Construction of navigation channels, locks, and water control structures has altered the historical north-south river and tidal-driven hydrology and shifted it to an east-west system that drains through the GIWW. The Corps' locks and water control structures that are located along the perimeter of the Lakes Sub-basin regulate both salinity and water level so that the Lakes Sub-basin now functions more as a freshwater reservoir and less as the low-salinity estuary that existed prior to these alterations (Gammill et al. 2002). The demand for a reliable fresh water supply for agricultural use was the primary reason for the development of the Mermentau Basin Project (U.S. Army Corps of Engineers 1999).

The Mermentau Basin Project involves the operation and management of five navigation locks and control structures: (1) the Calcasieu Lock located on the Gulf Intracoastal Waterway (GIWW) near the intersection of Louisiana Highway 384, (2) the Leland Bowman Lock situated on the GIWW near Intracoastal City, (3) the Freshwater Bayou Lock located on the Freshwater Bayou Canal approximately one mile north of the Gulf of Mexico, (4) the Catfish Point Control Structure located on the southwest side of the basin where the Mermentau River exits Grand Lake, and (5) the Schooner Bayou Control Structure located on the east side of the basin in the old Intracoastal Waterway between Freshwater Bayou and White Lake. The target water level inside the basin is 2.0 feet above mean low Gulf and the five Corps structures are operated in concert to maintain this level and preclude saltwater intrusion (U.S. Army Corps of Engineers 1999).

The Chenier Sub-basin is located south of the Lakes Sub-basin, between Louisiana Highway 82 and the Gulf of Mexico. Approximately one-third of this sub-basin is comprised of the State-owned and operated Rockefeller Wildlife Refuge. The Chenier Sub-basin is characterized by tidally influenced salt marshes, though hydrology throughout much of the area is managed through impoundments that range in size from hundreds to thousands of acres. The purpose of that management is to control salinity in order to reduce wetland losses and/or sustain recreational and agricultural endeavors (U.S. Army Corps of Engineers 2008).

Calcasieu-Sabine Basin

The Calcasieu-Sabine Basin extends from Sabine Lake and River eastward to the Louisiana Highway 27 segment east of Calcasieu Lake. The Calcasieu-Sabine Basin consists of two semi-distinct sub-basins, the Calcasieu River Basin and the Sabine River Basin. When the GIWW was built in the 1920s, it breached the Gum Cove Ridge which had historically formed a partial north-to-south oriented hydrologic barrier between the Calcasieu and Sabine Lake systems. That breach, in combination with several smaller canals, now facilitates water exchange between the sub-basins, and has exacerbated saltwater intrusion problems in the marshes adjacent to the GIWW. The typical water-movement scenario is that south winds push salt water into Calcasieu Lake, westward through the GIWW, and across the Gum Cove Ridge breach. This water is eventually swept down the Sabine River and into Sabine Lake. Currently, salt water that is pushed into Calcasieu Lake remains there because there is little back flow from the Lake. Without the Gum Cove Ridge breach, the current semi-circular flow patterns would not exist, and lake levels would rise more modestly, thus reducing the volume of seawater entering Calcasieu Lake (Lopez et al. 2008).

The widening and deepening (to -40 feet deep by 400 feet wide) of the Calcasieu River and Pass Ship navigation channel (referred to as the Calcasieu Ship Channel [CSC]), as well as the removal of the channel mouth bar, has increased saltwater and tidal intrusion into the Calcasieu-Sabine Basin,

resulting in marsh loss, tidal export of organic marsh substrate, and an overall shift to more saline habitats in the region. In 1968, the Corps completed construction of the Calcasieu River Saltwater Barrier on the Calcasieu River north of the City of Lake Charles. This barrier minimizes the flow of salt water into the upper reaches of the Calcasieu River to protect agricultural water supplies (Gammill et al. 2002). The Corps-maintained Calcasieu Lock, located east of the CSC on the GIWW near its intersection with Louisiana Highway 384, is operated to prevent saltwater intrusion into the Mermentau Basin as part of the Corps' Mermentau Basin Project.

The Sabine River has a drainage area of approximately 9,325 square miles and is the dominant influence across most of the Calcasieu-Sabine Basin in moderating salinity and tidal fluctuations. Sabine Pass was first dredged for navigation in 1880, and has been progressively deepened to its present depth of -40 feet. The Sabine-Neches Canal (later to become the Sabine-Neches Waterway) was constructed in the early 1900s. That channel not only facilitates saltwater intrusion into the area, it also funnels freshwater inflows more directly to the gulf, largely bypassing the adjacent marshes in Louisiana and Texas. A feasibility analysis has been conducted to deepen and widen the Sabine-Neches Ship Channel, but construction has yet to be initiated due to lack of funding. Saltwater intrusion in the Neches River has, in the past, necessitated the release of large quantities of water from the Sam Rayburn Reservoir to prevent saltwater contamination of industrial, agricultural, and municipal freshwater supply for Beaumont, Texas. To remedy those problems, a permanent saltwater barrier in the Neches River at Beaumont was constructed in 2003.

FISH AND WILDLIFE RESOURCE CONDITIONS

Existing Fish and Wildlife Habitats

The Chenier Plain consists of open water ponds and lakes, cheniers, gulf shorelines, and freshwater, intermediate, brackish, and saline marsh (Giron and Perez 2009). Marshes within Louisiana's Chenier Plain began forming about 3,000-4,000 years ago during periods when the Mississippi River occupied a more westerly course (Gosselink et al.1979). Expansive mud flats were created by large quantities of Mississippi River sediment that periodically accreted along the Gulf shoreline. When the river would shift to a more easterly location, erosion would rework the gulf shoreline to form beach ridges parallel to shore (Gammill et al. 2002). These ridges, consisting mainly of sand and shell, were typically higher in elevation than surrounding marshes and were colonized by live oaks. Early explorers called the ridges "cheniere," a French word meaning "place of oaks" (Kniffen and Hilliard 1988). Over time, a series of Gulf of Mexico shoreline transgressions and regressions caused by periodic shifting of the Mississippi channel from east to west resulted in the shore-parallel ridge and swale topography that dominates Louisiana's Chenier Plain today (Gammill et al. 2002). Despite substantial hydrologic alterations, wetlands of the Chenier Plain continue to support nationally significant fish and wildlife resources. They provide important habitat for various species of plants, fish and wildlife, and they serve as ground water recharge areas, provide storage areas for storm and flood waters, serve as natural water filtration areas, provide protection from wave action, erosion, and storm damage, and provide various consumptive and non-consumptive recreational opportunities. Predominant habitats and their associated fish and wildlife values are described below.

Forested Habitat

The four major forest types within the study area include swamp, bottomland hardwood, pine-oak forests, and upland chenier forest. Swamps are generally dominated with baldcypress, water tupelo, swamp red maple, and various understory plant species. Coastal swamp forests typically occupy the area between fresh marshes and areas of higher elevation, including the transition zones between bottomland hardwood forests on riverine interdistributary ridges and lower elevation marshes. Healthy cypress swamps occur in fresh water areas experiencing minimal daily tidal action and where the salinity range does not normally exceed 2 parts per thousand (ppt). Salinities of 3 ppt or higher may cause significant stress and mortality of baldcypress. However, short-term exposure to such salinities may be tolerated if it does not penetrate into and persist in the soil (U.S. Army Corps of Engineers 2009).

Bottomland hardwood forests occur primarily along the floodplains and distributary ridges of the various bayous and rivers within northern portions of the study area. Common tree species include sugarberry, water oak, live oak, nuttall oak, overcup oak, bitter pecan, black willow, American elm, swamp red maple, box elder, green ash, and baldcypress (U.S. Army Corps of Engineers 2009).

The suppression of fire within area pine flatwoods has resulted in the conversion of those forests to pine-oak forests. These pine-oak forests are generally found on poorly drained flats and depressional areas north of the GIWW and predominantly around the cities of Sulphur and Lake Charles. Common tree species include loblolly pine, slash pine, longleaf pine, water oak, laurel oak, sweet bay, sweetgum, rough-leaf dogwood, and wax myrtle. These former pine flatwood communities may also contain a very diverse herbaceous community that can include many state rare species (U.S. Army Corps of Engineers 2009).

A unique feature of the Chenier Plain is the chenier ridge habitat that formed on abandoned beach ridges. These ancient beaches, composed primarily of sand and shell fragments, were stranded behind prograding shorelines built during periods of sedimentation fed by the Mississippi River. Common tree species on cheniers include live oak, sugarberry, swamp red maple, sweetgum, and water oak. Red mulberry, toothache-tree, and sweet acacia also occur on these ridges (U.S. Army Corps of Engineers 2009). Cheniers are important storm surge buffers, often serving as hydrologic barriers that limit saltwater intrusion into interior marshes (U.S. Army Corps of Engineers 2008). Wooded habitats on the cheniers are critically important stopover habitat for neotropical songbirds migrating across the Gulf (Moore and Simons 1992, Moore 1999).

Scrub-Shrub Habitat

Scrub-shrub habitat within the study area often occupies a zone where marshes transition into slightly higher elevation habitats. Scrub shrub habitats are found along bayou ridges and on dredged material embankments, and areas typically bordered by marsh, swamp, or bottomland hardwoods. In saline areas, scrub-shrub communities are dominated by black mangrove on flooded saltmarsh edges, or by marsh elder and eastern baccharis on low ridges, bayou banks, and spoil banks and other disturbed areas. Brackish scrub-shrub wetlands are also dominated by eastern baccharis and marsh elder, although wax myrtle is common on low ridges, bayousides, and spoilbanks as well. Typical scrub-shrub vegetation in intermediate and fresh areas includes elderberry, wax myrtle, buttonbush, rattlebox, swamp red maple, Chinese tallow tree, marsh elder, and eastern baccharis. Dwarf palmetto and prickly pear cactus are common in the understory of Chenier/maritime forest. Yaupon, dwarf palmetto, swamp privet and Virginia willow also occur in thickets and the understory

of swamps and bottomland hardwood forests (U.S. Army Corps of Engineers 2009). Those habitats often support a variety of wildlife, depending on local conditions; they provide nesting and feeding sites for wading birds, songbirds and other birds, and wildlife escape cover.

Fresh Marsh

Freshwater marshes are quite heterogeneous, with local species composition governed by frequency and duration of flooding, micro-topography, substrate, current flow and salinity. This marsh type is typically dominated by maidencane, duck potato, spikerushes, pennywort, elephant-ear and alligatorweed. Other common plants are California bulrush, giant cutgrass, beggarticks and cattail. Fresh marshes are often very diverse with different species of grasses and broad-leaved annuals waxing and waning throughout the growing season. Chabreck (1972) documented 93 plant species occurring in the fresh marshes of coastal Louisiana. In some areas, fresh marshes consist of nearly pure stands of maidencane. Aquatic plants commonly found in fresh marsh waters are duckweed, coontail, Eurasian watermilfoil, southern naiad, water hyacinth, pondweeds, white waterlily, elodea, hydrilla, water celery, water shield, fanwort, American lotus, and several invasive species of *Salvinia*. Fresh marsh salinity rarely exceeds 2 ppt, with a year-round range of approximately 0.5-1 ppt.

Canal-induced saltwater intrusion has drastically reduced the extent of fresh marsh that historically existed within the Calcasieu-Sabine Basin (Figure 2). However, fresh marsh remains the dominant marsh type within the upper Lakes Sub-basin of the Mermentau Basin (Figure 3).

Freshwater marshes support extremely high densities migratory waterfowl and other wildlife.

However, because of saltwater intrusion, freshwater marshes have undergone the highest rate of reduction in acreage of any of the marsh type in Louisiana over the past few decades.

Figure 2. Marsh types (2007) within the Calcasieu-Sabine Basin.

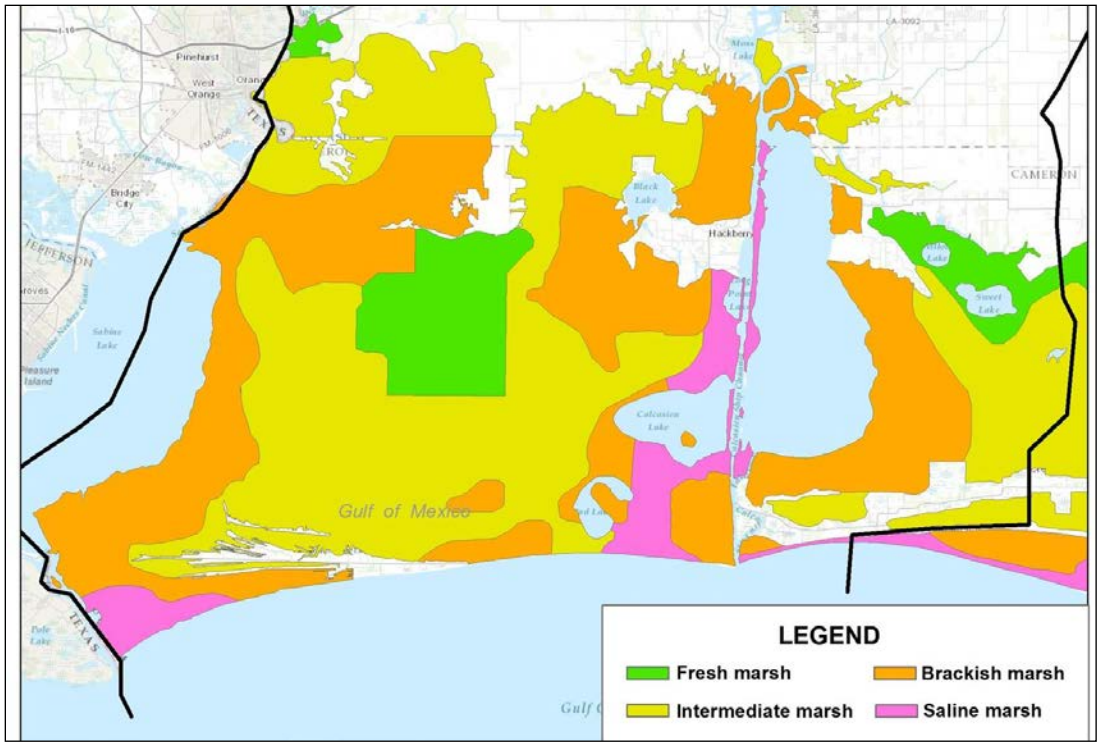


Figure 3. Marsh types (2007) within the Mermentau Basin.

Intermediate Marsh

Intermediate marsh may occur when annual salinity averages 3 to 4 ppt; but often intermediate marsh salinities may be fresh for much of the year with higher salinity conditions occurring during the late summer and early fall. Chabreck's (1972) identification of 54 species of plants in intermediate marsh indicates that plant species richness is relatively high. The intermediate marsh can be difficult to identify, as it sometimes may not appear as a transitional zone between brackish and fresh marshes. Saltmeadow cordgrass or duck potato is usually the dominant or co-dominant species. These are commonly accompanied by three-cornered grass, common reed, seashore paspalum, coastal waterhyssop, California bulrush, Walter's millet, sawgrass, deer pea, spikerushes, and flatsedges. Aquatic plant species found in intermediate marsh waters include widgeon grass, Eurasian watermilfoil, water celery, and southern naiad. Intermediate marshes are considered extremely important for many wildlife species, such as alligators and wading birds, and serve as important nursery areas for juvenile marine organisms. Although still a common natural community type in Louisiana, intermediate marsh appears to be declining in aerial extent, which has been attributed to a shift toward brackish marsh due to increased salinity levels. Visser et al. (2000), expanding on previous studies by Penfound and Hathaway (1938) and Chabreck (1970), classified intermediate marsh in the Chenier Plain as a combination of sawgrass, saltmeadow cordgrass, and California bulrush.

Intermediate marsh occurs within the more interior portions of the Calcasieu-Sabine Basin where exposure to saltwater intrusion is lessened by distance from saltwater sources. Intermediate marsh may have an irregular tidal regime, with salinity ranging from 3 to 10 ppt. This marsh type is very important to many species of avian wildlife and supports large numbers of wintering waterfowl. It is also critical nursery habitat to juvenile marine organisms. Gradual changes in salinity conditions can cause this habitat to shift towards brackish marsh.

Brackish Marsh

Inland from salt marsh, and subject to moderate tidal influence, are brackish marshes. This marsh type is dominated by saltmeadow cordgrass. Brackish marshes are often interspersed with numerous small ponds and water channels and have experienced substantial marsh breakup and degradation in recent years. Salinity levels often range between 0.5 to 5.0 ppt and average salinity is in the range of 8 ppt, however, much higher salinities may occur periodically. In the brackish marsh, saltmeadow cordgrass is the dominant herbaceous species. Saltgrass, three-cornered grass, smooth cordgrass, black needlerush, and leafy three-square are often co-dominant or common in this zone. It should be noted that some of these species also occur in saline marsh, but the order of dominance differs. Chabreck (1972) identified forty species of plants in brackish marsh. Aquatic plants that commonly occur in brackish marsh waters include widgeon grass, Eurasian watermilfoil, water celery, and horned pondweed. Visser et al. (2000) classified brackish marsh in the Chenier Plain as a combination of saltmeadow cordgrass, three-cornered grass, and leafy three square.

Brackish marshes occur predominantly along the borders of Calcasieu and Sabine Lakes. Brackish marshes are extremely important as nurseries for fish and shellfish. Wading birds, muskrats and shorebirds are also common in such areas.

Saline Marsh

Salt marshes usually receive regular tidal inundation and occur in the most saline zones along the Gulf of Mexico shoreline and adjacent to the Calcasieu Ship Channel. Smooth cordgrass is the dominant plant in this marsh type, and often forms near-monotypic stands. Herbaceous vegetation of the saline marsh is typically dominated by smooth cordgrass intermixed with saltgrass, saltmeadow cordgrass, black needlerush, and saltwort. Chabreck (1972) identified 12 species of emergent vegetation typically associated with this marsh type. Within the described marsh zones, many ponds and lakes support submerged and/or floating-leafed aquatic vegetation (SAV). Aquatic vegetation is rare in saline waters along the Louisiana coast (Chabreck, 1972). However, widgeon grass may occur in open water areas of saline marshes bordering on the brackish marsh zone and in saline areas where tidal flow has been decreased by structures or other changes in hydrology. Average salinity is approximately 16 ppt. Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some species like seaside sparrows and clapper rails are common (U.S. Army Corps of Engineers 2009). Salinity levels may range from 5.0 to 18 ppt, however, salinities may occasionally be lower or higher.

Saline marsh habitat exists in the project area closest to the Gulf of Mexico beach rim and along the Lower Lake (i.e., river miles (RMs) 5 to 12) and Calcasieu Pass (i.e., RMs 0 to 5) portions of the Calcasieu Ship Channel. Saline marshes are regularly flooded by high tides and have less plant diversity than the other marsh types.

Open Water

Small ponds and shallow open water areas associated with each of the above marsh plant communities are scattered throughout the project area. Some of the larger well known open water areas include Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake along the ship channel. Black Lake, Browns Lake, and Mud Lake are open water areas occurring west of the ship channel. Willow Lake and Sweet Lake occur east of the ship channel.

Submerged Aquatic Vegetation Habitat

Some protected shallow open water habitats within the project area support submerged aquatic vegetation (SAV). Prior to Hurricane Rita concentrations of SAVs densities up to 80 percent coverage occurred within Cameron Prairie National Wildlife Refuge (NWR) and those concentrations are expected to return (personal communication with NWR personnel 2007). Project area SAV habitats may include areas of widgeon grass, duckweeds, coontail, bladderworts, watermilfoil, hydrilla, mermaidweeds, and pondweeds. As these aquatic plants die, their decomposition by bacteria and fungi contribute to the food web by providing detritus for many aquatic invertebrates. SAVs are very important to wildlife and are utilized by many duck species.

Developed Lands

Developed areas are located on the higher elevations of the Pleistocene terrace along the GIWW and around the Lake Charles area and are typically well drained. Within the coastal marshes, most development is located on cheniers. They include agricultural lands and commercial and residential developments. Levees are also included in this category. Levees are frequently mowed, and, as such, provide poor wildlife habitat. Some levees are vegetated with an assortment of scrub/shrub species including marsh elder, eastern baccharis, Chinese tallow tree, common reed, and goldenrod.

These higher-elevation areas may provide low-to-moderate-value habitat for terrestrial wildlife, including some migratory bird species.

Existing Fishery Resources

The project-area wetlands and associated shallow waters provide nursery and feeding habitat for recreationally and commercially important estuarine-dependent fishes and shellfishes (e.g., red drum, black drum, Atlantic croaker, spot, sand seatrout, spotted seatrout, southern flounder, Gulf menhaden, striped mullet, blue crab, white shrimp and brown shrimp). Commercial shrimp harvests have been positively correlated with the area of tidal emergent wetlands (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes would likely be adversely impacted by continued losses in estuarine marsh habitat (Turner 1982). Portions of the project area also provide habitat for freshwater fishes that can tolerate low-salinity conditions, including largemouth bass, bluegill, warmouth, gars, freshwater drum, blue catfish and channel catfish.

Salt and brackish marshes serve as nursery areas for myriads of juvenile shrimp, crabs, redfish, seatrout, Gulf menhaden, etc., and greatly enhance the production of marine organisms. Vegetation production rates in estuarine marshes are extremely high, providing an abundance of detritus to support the estuarine food web.

Much of the existing project area-wetlands are subject to permitted structural management that varies from semi-impounded to completely impounded marsh. The majority of the water control structures within the semi-impounded management areas are supposed to be operated to allow ingress and egress of estuarine fishery organisms, especially brown shrimp and white shrimp, except during drawdowns, periods of high salinity, or waterfowl seasons. Unmanaged coastal wetlands are of particular importance due to their relative scarcity within the Calcasieu-Sabine Basin.

Essential Fish Habitat

Estuarine wetlands and associated shallow waters within the project area have been identified as Essential Fish Habitat (EFH) for both postlarval, juvenile and sub-adult stages of brown shrimp, white shrimp, and red drum, as well as the adult stages of those species in the nearshore and offshore reaches. EFH in the nearshore, marine-portion of the project area and in the lower portions of the estuary has also been designated for the following species and their associated life stages: lane snapper, larvae and juvenile life stages; dog snapper, juvenile life stage; and bonnethead shark, juvenile life stage. EFH requirements vary depending upon species and life stage. Categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), (P.L. 104-297). Estuarine-dependent species such as those listed above also serve as prey for other species managed under the MSFCMA by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species (e.g., billfishes and sharks) managed by the NOAA-Fisheries.

Existing Wildlife Resources

The project area supports an array of productive coastal habitats, dominated by intermediate and brackish marshes and associated shallow estuarine waters. The project-area wetlands and adjacent shallow waters, as well as the chenier ridges, support numerous federal-trust wildlife resources, including migratory birds, threatened and endangered species, and various federal and private land holdings that are held or managed to benefit those species.

The chenier and coastal forest habitats associated with the project area provide nesting habitat for songbirds (e.g., the mockingbird, yellow-billed cuckoo, brown thrasher and northern parula), as well as stopover areas for trans-Gulf migrating songbirds. Other avian species found in project area's forested habitats include the American woodcock, common yellow-shafted flicker, belted kingfisher, and several species of raptors (e.g., red-tailed hawk and red-shouldered hawk). Wading bird colonies containing species such as anhinga, great egret, and great blue heron typically occur in wooded wetland and scrub-shrub habitat.

Mammals associated with the project area forested habitats include game species such as eastern cottontail, swamp rabbit, white-tailed deer, and gray and fox squirrels; commercially important furbearers such as river otter, muskrat, and nutria; and other mammal species such as striped skunk, coyote, nine-banded armadillo, and Virginia opossum. Smaller mammals such as the cotton rat, marsh rice rat, and white-footed mouse serve as forage for both mammalian and avian carnivores.

Reptiles which utilize study-area forested habitats include the ground skink, five-lined skink, green anole, and western ribbon snake, and numerous other species. Some of the amphibians expected to be found in study-area forested habitats including small-mouthed salamander, green treefrog, bullfrog, and southern leopard frog.

Wildlife expected to utilize the study-area estuarine marshes include wading birds (e.g., herons, egrets, ibises, and roseate spoonbills), rails, migratory waterfowl (e.g., green-winged teal, blue-winged teal, mottled duck, gadwall, American widgeon, and lesser scaup), raptors, and songbirds. Brackish marshes having abundant submerged aquatic vegetation often support large numbers of puddle ducks. Shorebirds utilizing estuarine marshes include killdeer, American avocet, black-necked stilt, American oystercatcher, common snipe, and various other species. Seabirds include white pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. Other nongame birds such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, belted kingfisher, and sedge wren also utilize estuarine marshes.

Estuarine marsh wildlife also includes swamp rabbit, nutria, muskrat, mink, river otter, raccoon, white-tailed deer, and coyote. Reptiles are limited primarily to the American alligator in intermediate and brackish marshes, and the diamond-backed terrapin and gulf salt marsh snake in brackish and saline marshes. Juvenile sea turtles may seasonally utilize bays and saline marsh ponds in the lower Calcasieu Estuary.

Species of Management Concern

Species of fish, wildlife, and plants labeled as "S1" and S2" by the Louisiana Department of Wildlife and Fisheries are rare species that are vulnerable to extirpation in Louisiana. These species, along with those identified as priority species by the Gulf Coast Joint Venture are species of management concern. Continued population declines could result in these species becoming candidates for listing under the Endangered Species Act.

Species of concern which use project area Gulf beaches include snowy plover, Wilson's plover, long-billed curlew, Hudsonian godwit, gull-billed tern, reddish egret, black skimmer, and peregrine falcon. An "S2" plant found on beaches in Cameron Parish is the wedge leaf prairie clover. Species of concern that would use project area intermediate, brackish and saline marsh habitat and adjacent open waters include the Louisiana-eyed silk moth, glossy ibis, seaside sparrow, black rail, mottled duck, and the peregrine falcon.

Threatened and Endangered Species

Federally listed threatened or endangered species that occur within the study area include the piping plover (*Charadrius melodus*), the red knot (*Calidris canutus rufa*), the whooping crane (*Grus americana*), and the West Indian manatee (*Trichechus manatus*). Also, threatened and endangered species of sea turtles are known to occur in the southern portion of Calcasieu Lake and/or in nearshore Gulfwaters including the green sea turtle, the hawksbill sea turtle, the Kemp's Ridley sea turtle, the leatherback sea turtle.

The Sprague's pipet (*Anthus spragueii*) is a candidate species for federal listing as a threatened or endangered species

The piping plover, federally listed as a threatened species, as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change; and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to erosion, development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. If implementation of the proposed action has the potential to directly or indirectly affect the piping plover or its critical habitat, further consultation with this office will be necessary.

The red knot (*Calidris canutus rufa*), was listed as a threatened species in December 2014. It is a medium-sized shorebird about 9 to 11 inches (23 to 28 centimeters) in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot breeds in the central Canadian arctic but is found in Louisiana during spring and fall migrations and the winter months (generally September through March).

During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and they roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams (*Donax variabilis*), a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation. If implementation of the proposed action has the potential to directly or indirectly affect the red knot or its habitat, further consultation with this office will be necessary.

Beginning in 2010, the Louisiana Department of Wildlife and Fisheries, in cooperation with the U.S. Fish and Wildlife Service and the U.S. Geological Survey, began efforts to establish a nonmigratory flock of whooping cranes (*Grus americana*) into historic southwestern Louisiana habitat on the state-owned White Lake Wetlands Conservation Area in Vermilion Parish, Louisiana. This reintroduced population was designated as a nonessential experimental population (NEP) under section 10(j) of the Endangered Species Act of 1973 (ESA), as amended. A NEP population is a reintroduced population believed not to be essential for the survival of the species, but important for its full recovery and eventual removal from the endangered and threatened list. These populations are treated as "threatened" species except that the ESA's section 7 consultation regulations (requiring consultation with the U.S. Fish and Wildlife Service to reduce adverse impacts from Federal actions) do not apply (except where the species occurs within National Parks or National Wildlife Refuges) and critical habitat cannot be designated. The only natural wild population of the endangered whooping crane remains vulnerable to extirpation through a natural catastrophe or contaminant spill, due primarily to its limited wintering distribution along the Texas gulf coast.

The Sprague's pipit (*Anthus spragueii*), is a candidate species for federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Migration and wintering ecology of this species is poorly known, but Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. Its use of an area is dependent upon habitat

conditions. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds.

There is currently no requirement under the Endangered Species Act for consultation regarding project impacts on candidate species. In the interest of conserving the Sprague's pipit, we encourage the Corps to avoid project activities that would adversely affect this species or its habitat. Should it be federally listed as threatened or endangered in the future, however, further consultation on project impacts to this species would then be necessary.

West Indian manatees, federally listed as an endangered species, occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatees have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

All contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations would be resumed. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).)

The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning these and other sea turtle species in their aquatic environment.

Wildlife Management Areas and Parks

Sabine National Wildlife Refuge (NWR) is comprised of 124,511 acres of coastal marsh west of the Calcasieu Lake, and its primary management objective is to preserve a large area of coastal wetlands for wintering and migrating waterfowl from both the Mississippi and Central Flyways. This refuge is also a major nursery area for many estuarine-dependent marine species as well as being the home for alligators and other reptiles, mammals, and numerous wading, water and marsh birds. Cameron

Prairie NWR is located east of Calcasieu Lake. Two units (i.e., the Gibbstown and East Cove units) compose this refuge and provide fresh marsh and brackish to saline marsh habitats to support alligators, cottonmouth snakes, white-tailed deer, rabbits, roseate spoonbills, and more than 200 other birds, as well as shrimp, crabs, and many species of fish. Lacassine NWR is located in the Mermentau Basin, northwest of Grand Lake, and is very heavily used by wintering waterfowl. Should proposed project activities directly or indirectly affect those NWRs, please contact Mr. Don Voros, the Southwest Louisiana National Wildlife Refuge Complex Leader (337-598-2216), to obtain a Compatible-Use Determination, and to ascertain the need for a Special Use Permit that may be required should work be conducted on that NWR. The Rockefeller Wildlife Refuge, owned and operated by the Louisiana Department of Wildlife and Fisheries is located south of Grand Chenier in the Mermentau Basin. This 76,000-acre refuge consists of numerous tidal marsh management units operated to provide habitat for wintering migratory waterfowl. Project activities on Rockefeller Refuge should be coordinated with the Refuge manager (337-491-2593).

Future Fish and Wildlife Resources

Loss of coastal marshes is the primary problem affecting study area fish and wildlife resources.

Satellite land acreage data (1985-2010) from the U.S. Geological Survey (USGS) was plotted and linear regressions were used to calculate average annual loss rates in percent of 1985 acres per year. Regression derived acreages were aggregated to generate regional loss rates (Figure 4).

Throughout the study area, an average of 930 acres has been lost per year from 1985 to 2010 (Table 1). Hurricane Rita (2005) and Hurricane Ike (2008) caused substantial marsh losses and have likely driven marsh loss rates higher than the rates that existed prior to those storms.

Figure 4. Average annual regional marsh acreage change from 1985 to 2010 (percent per year).

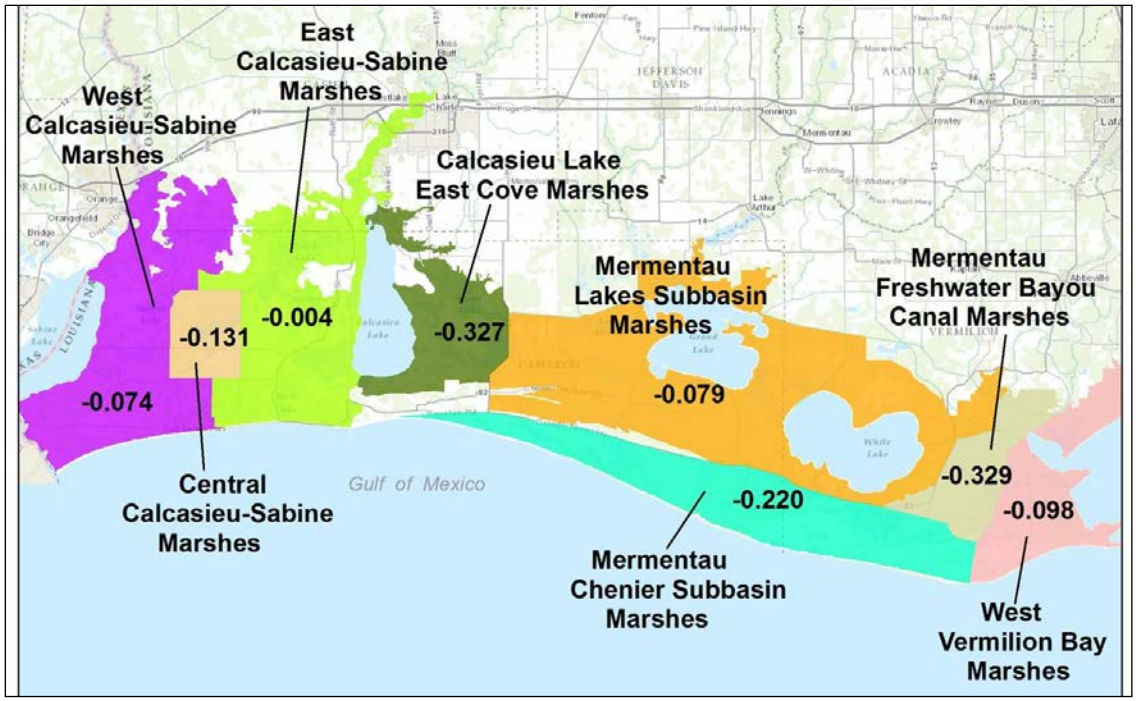


Table 1. Average annual marsh acres lost (1985 to 2010).

Calcaiseu-Sabine Basin				Mermentau Basin	
West Cal-Sab Marshes	Central Cal-Sab Marshes	East Cal-Sab Marshes	East Calcasieu Lake Marshes	Merm. Lakes Subbasin Marshes	Merm. Chenier Subbasin Marshes
-119	-39	-5	-197	-231	-338
			-361		-569

Marsh loss within the West Calcasieu-Sabine marshes is the result of recent rapid losses in the Cameron Meadows Oil and Gas Field north of Johnsons Bayou. Observations suggest that the marsh in this area has drowned and was likely caused by mineral extraction related subsidence of the vegetated marsh surface. Except for this area, the region was experiencing minimal marsh loss prior to Hurricanes Rita and Ike. Central and East Calcasieu-Sabine regions were relatively stable until impacted by Hurricanes Rita and Ike. Recent marsh creation and dredged material disposal efforts have partially offset hurricane related losses in that east region. Marshes east of Calcasieu Lake and throughout the Mermentau Basin were also adversely impacted by these recent hurricanes.

A major cause of marsh loss in the Calcasieu-Sabine Basin has been saltwater intrusion caused by the construction and enlargement of the Calcasieu River and Pass navigation channel, the GIWW, and the Sabine Neches Waterway (LCWCRTF 1998). Those deep-draft channels increased salinity levels, water levels, and duration of high tides (Suhayda et al. 1989) throughout the estuary. The increased salinity stressed fresh and intermediate marsh vegetation, contributing to plant death and ultimately conversion of those marshes to shallow open water. Those hydrology changes resulted in the rapid conversion of interior low-salinity marshes to open water and brackish marshes. Once those losses had occurred, loss rates decreased as the most vulnerable areas had become open water. However, saltwater intrusion continues to impact sensitive low-salinity marsh areas during drought-induced high salinity periods.

Prior to Hurricanes Rita and Ike, the Lakes Sub-basin marshes and other study area marshes were relatively stable. However, significant study area marsh loss occurred prior to 1985

Other Mermentau Basin problems include shoreline erosion along the Gulf of Mexico, which is greatest in the vicinity of Rockefeller Refuge where 30 to 40 feet per year is lost to the Gulf (van Beek and Meyer-Arendt 1982 and Williams et al. 1992).

Shoreline erosion is also a problem along the shores of large lakes such as Calcasieu Lake, Sabine Lake, Grand Lake, and White Lake. Ship wakes and wind waves are the predominant mechanism of erosion causing the Calcasieu Ship Channel to widen at an average of 7.5 feet per year in this reach (Fischenich 2004).

Using tide gage data from the Sabine Pass tide gage and U.S. Army Corps of Engineers methods, a subsidence rate of 3.9 mm/year has been calculated and is assumed to be the rate affecting the entire study area. The combination of subsidence and sea level rise is called submergence or relative sea level rise. Submergence causes marshes to become inundated with higher water levels, stressing

most non-fresh marsh plants and leading to plant death and conversion of marshes to open water. Other major causes of study-area marsh loss include altered hydrology, storm events, and developments including the direct and indirect impacts of dredge and fill activities (LCWCRTF 1998).

Wetland losses result in increasing acreage of open water. Continued wetland losses are expected to cause significant declines in coastal fish and shellfish production and in the study area's carrying capacity for migratory waterfowl, wading birds, other migratory birds, alligators, furbearers, and game mammals such as white-tailed deer and swamp rabbit. Wetland losses will also reduce storm surge protection of developed lands, and will likely contribute to water quality degradation associated with excessive nutrient inputs.

Aside from marsh loss, saltwater intrusion has converted fresh marsh habitats to more brackish communities. Marshes not hydrologically managed will continue to provide habitat for more salt tolerant species. Because of continued saltwater intrusion, habitat quantity and quality for freshwater fishes, waterfowl, alligators, and more freshwater-tolerant estuarine species (i.e., Gulf menhaden, white shrimp) will continue to decrease throughout most of this area. Habitat quantity will increase for species such as brown shrimp, spotted seatrout, and black drum, which prefer brackish and saline conditions (LCWCRTF 1999). However, continued degradation of those brackish and saline marshes may reduce production of those fish and shellfish.

DESCRIPTION OF ALTERNATIVES AND RECOMMENDED PLAN

Project goals are to provide hurricane protection and ecosystem restoration that improves ecosystem sustainability. Specific planning objectives were identified to solve the problems by taking advantage of opportunities (Table 2).

Table 2. Protection and restoration planning objectives.

Objective No.	Objective Description
1	Reduce the risk of damages and losses from hurricane and storm surge flooding in southwest Louisiana
2	Manage tidal flows in southwest coastal Louisiana to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh
3	Increase wetland productivity in southwest coastal Louisiana in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
4	Reduce shoreline erosion and stabilize canal banks in southwest coastal Louisiana areas to protect adjacent wetlands.
5	Restore landscapes, including marsh, shoreline, and cheniers in southwest coastal Louisiana, to maintain their function as wildlife habitat and improve their ability to serve as protective barriers

Levee alternatives were developed and evaluated to provide storm surge protection for the communities of Lake Charles/Sulphur and Abbeville/Erath/Delcambre. Each of those alignments was evaluated at levee heights to protect against 0.5 percent, 1.0 percent, and 2.0 percent annual chance of occurrence storms. In addition to those traditional levee alternatives, non-structural alternatives consisting of buyouts and elevating flood prone structures have also been evaluated throughout the study area.

None of the protection levee alternatives were cost efficient. However, non-structural protection measures did provide a cost-efficient alternative within some regions of the project area and hence, non-structural measures for those regions were selected for inclusion in the TSP (Figure5). Those non-structural measures will include the construction of 3-7 foot high earthen berms around specific structures. Where construction of those berms could result in impacts to adjacent wetlands, sheetpile structures will be constructed in lieu of earthen berms.

Figure 5. Map of non-structural protection reaches included in the TSP.

Ecosystem restoration measures were classified into either hydrology/salinity control measures, marsh creation measures, shoreline protection measures, chenier restoration/reforestation, or oyster reef restoration measures (to improve wetland hydrology). The hydrology/salinity control measures consist of water control structures and/or navigation locks at Sabine Pass and Calcasieu Pass to reduce saltwater intrusion into the estuary, or control structures to reduce marsh flooding and saltwater intrusion from Calcasieu Lake into interior marshes. Marsh creation and shoreline protection measures were strategically located to protect areas where erosion and marsh loss could

result in the establishment of new channels connecting the Gulf of Mexico with interior marshes. Candidate measures were screened based on cost effectiveness, and only the most cost effective measures were retained.

The retained measures were then combined to create an array of restoration alternatives (Table 3). Alternative 1, the Large Integrated Restoration across Basins plan, incorporates all hydrology/salinity control measures, except the Gum Cove Ridge control structure, plus the full array of marsh creation and shoreline protection features, plus all chenier restoration features. Alternative 2, the Moderate Integrated Restoration plan, is similar to Alternative 1 except that it has a reduced number of marsh creation and shoreline protection features. Alternative 3, the Moderate Integrated Restoration Plan with Gum Cove, is identical to Alternative 2 except that it includes the Gum Cove Ridge water control structure. Alternative 4, the Entry Salinity Control plan, includes the water control structures that regulate exchange with the Gulf (this includes the Catfish Point structure), plus a lesser number of marsh creation and shoreline protection features compared to Alternatives 2 and 3.

Table 3. Ecosystem restoration alternatives evaluated.

Alternative Number	Alternative Description
1	Large Integrated Restoration Across Basins
2	Moderate Integrated Restoration
3	Moderate Integrated Restoration w/ Gum Cove
4	Entry Salinity Control Focus
5	Interior Perimeter Control Focus
6	Marsh & Shoreline Focus

Chenier restoration is included in this and all alternatives. Alternative 5 is similar to Alternative 4 except that Alternative 5, the Interior Perimeter Control plan, includes hydrology/salinity control measures that are limited to the interior perimeter control structures (including the Catfish Point structure and the Gum Cove Ridge structure). Chenier restoration is included in Alternative 5. Alternative 6, the Marsh and Shoreline plan, includes the same interior perimeter hydrology/salinity control measures, minus the Gum Cove control structure, and it includes all marsh creation measures, most of the shoreline protection measures, and all chenier restoration measures.

Restoration Alternative 4 (Entry Salinity Control Alternative), minus the Calcasieu Pass control structure, was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass salinity control structure (measure 48) and the freshwater retention structure on Little Pecan Bayou (measure 13). Shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6b1, 6b2, and 6b3) were also added to the TSP. Given its complexity, the Calcasieu Pass salinity reduction structure will be pursued via a separate and independent feasibility analysis. The Cameron-Creole Watershed Spillway, remains in the TSP, but is poorly defined and benefits for this feature are not yet determined. TSP measures in the Calcasieu-Sabine and the Mermentau Basins are illustrated in Figures 6 and 7, respectively, and listed in Table 4

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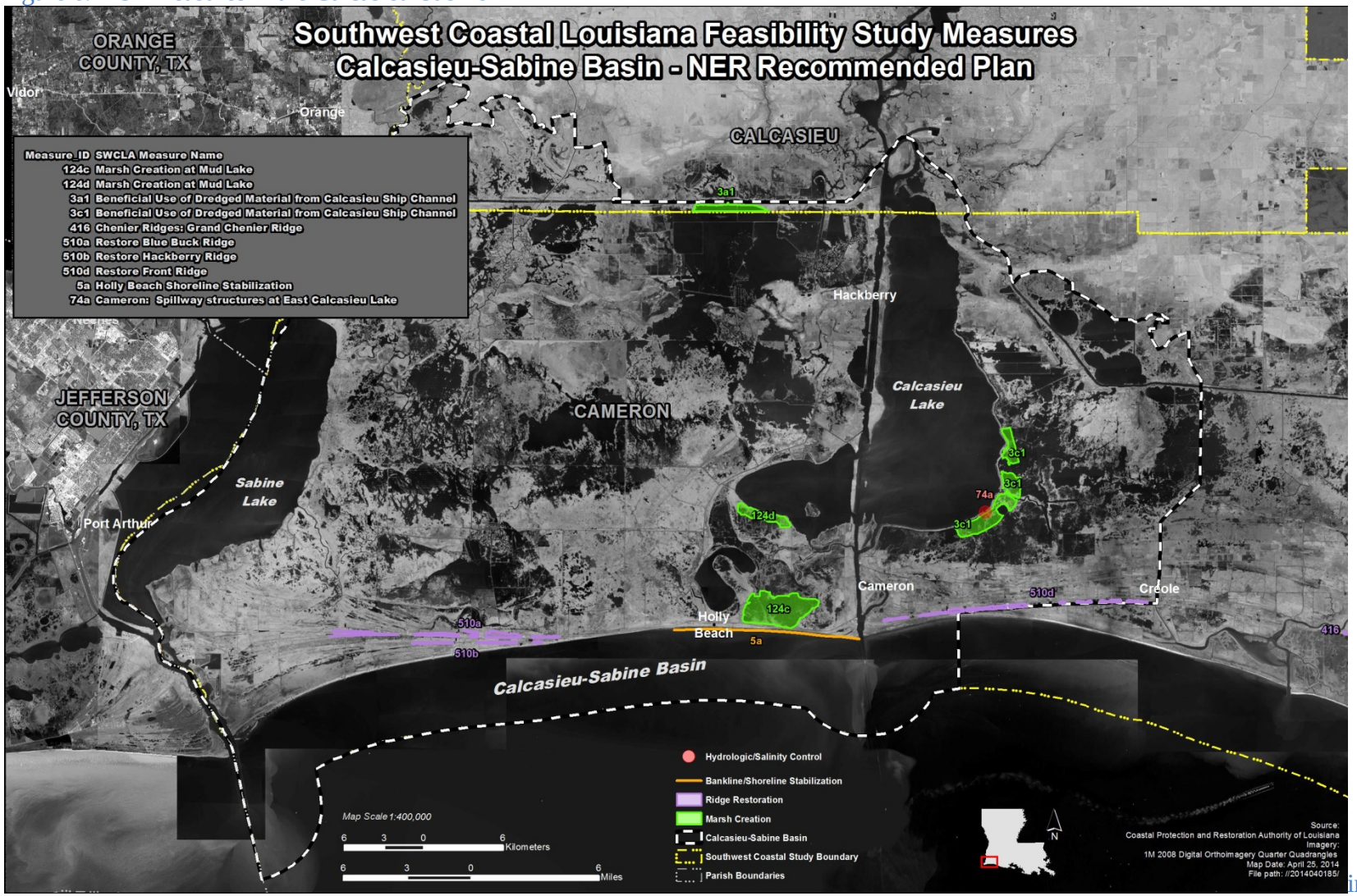
Figure 6. TSP measures in the Calcasieu-Sabine



in

Figure 7. TSP measures in the Mermentau Basin.

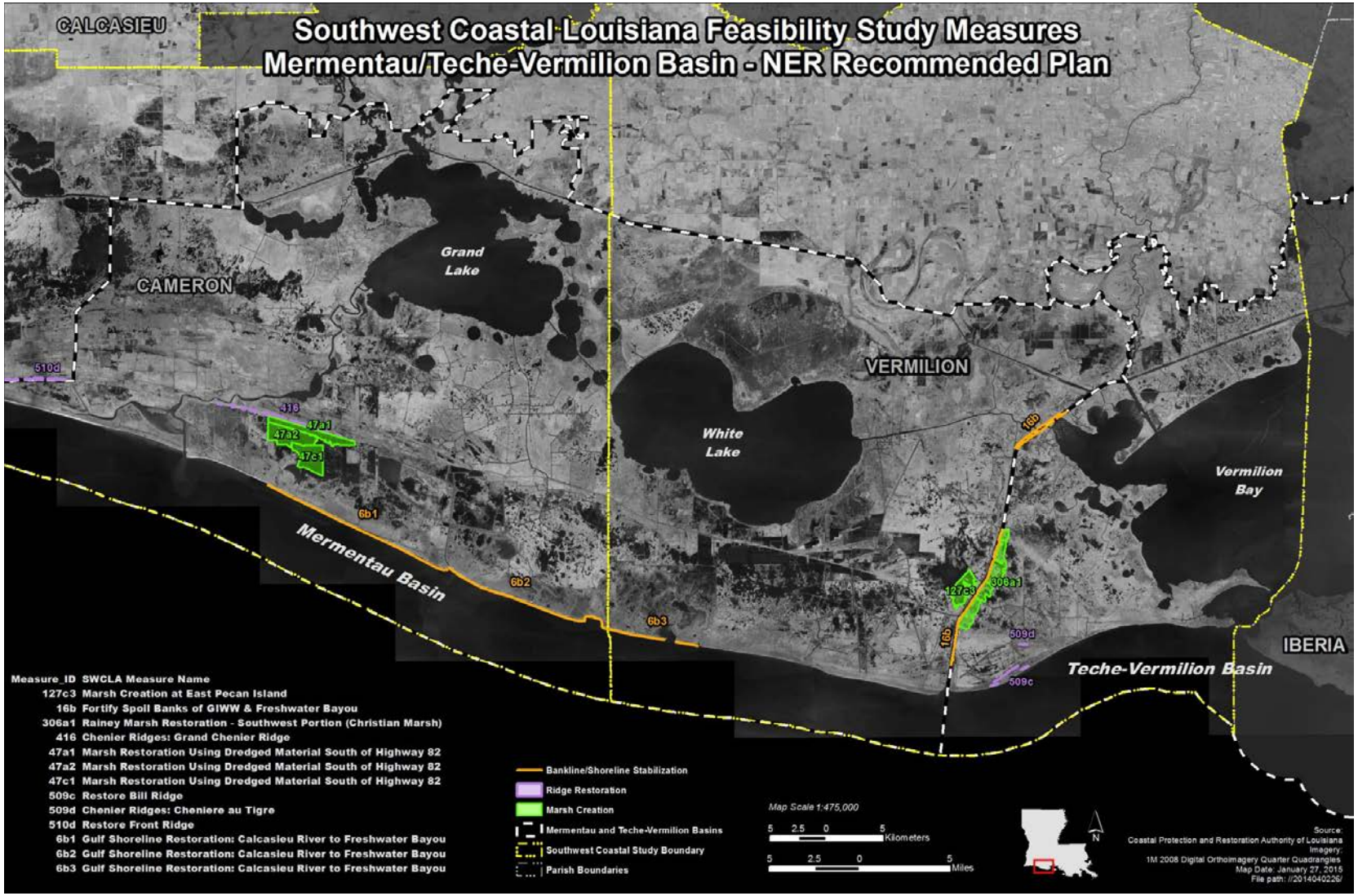

Southwest Coastal Louisiana Feasibility Study Measures
Mermentau/Teche-Vermilion Basin - NER Recommended Plan
CALCASIEU
CAMERON
VERMILION
IBERIA
Grand Lake
White Lake
Vermilion Bay
Mermentau Basin
Teche-Vermilion Basin
510d
416
47a1
47a2
47c1
6b1
6b2
6b3
16b
127c3
306a1
509d
509c
Measure_ID SWCLA Measure Name
127c3 Marsh Creation at East Pecan Island
16b Fortify Spoil Banks of GIWW & Freshwater Bayou
306a1 Rainey Marsh Restoration - Southwest Portion (Christian Marsh)
416 Chenier Ridges: Grand Chenier Ridge
47a1 Marsh Restoration Using Dredged Material South of Highway 82
47a2 Marsh Restoration Using Dredged Material South of Highway 82
47c1 Marsh Restoration Using Dredged Material South of Highway 82
509c Restore Bill Ridge
509d Chenier Ridges: Cheniere au Tigre
510d Restore Front Ridge
6b1 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
6b2 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
6b3 Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou
Bankline/Shoreline Stabilization
Ridge Restoration
Marsh Creation
Mermentau and Teche-Vermilion Basins
Southwest Coastal Study Boundary
Parish Boundaries
Map Scale 1:475,000
5 2.5 0 5 Kilometers
5 2.5 0 5 Miles
N
Source:
Coastal Protection and Restoration Authority of Louisiana
Imagery:
1M 2008 Digital Orthoimagery Quarter Quadrangles
Map Date: January 27, 2015
File path: //201404022G/

Table 4. Restoration measures comprising the TSP, listed by basin.

Basin	Measure Type	Measure Number	Measure Description
CS	Hydrology	74a	Cameron spillway structure at east Calcasieu Lake
CS	Marsh Creation	124c	Marsh creation at Mud Lake
CS	Marsh Creation	124d	Marsh creation at Mud Lake
CS	Marsh Creation	3a1	Beneficial use of dredged material from ship channel
CS	Marsh Creation	3c1	Beneficial use of dredged material from ship channel
CS	Shoreline Prot.	5a	Holly Beach shoreline protection
CS	Chenier Rest.	416	Chenier restoration: Grand Chenier
CS	Chenier Rest.	510a	Chenier restoration: Blue Buck Ridge
CS	Chenier Rest.	510b	Chenier restoration: Hackberry Ridge
CS	Chenier Rest.	510d	Chenier restoration: Front Ridge
Merm	Marsh Creation	127c3	Marsh creation at east Pecan Island
Merm	Marsh Creation	306a1	Marsh creation at Rainey marsh (SW portion)
Merm	Marsh Creation	47a1	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47a2	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47c1	Marsh creation using dredged material south of Hwy 82
Merm	Shoreline Prot.	16b	Fortify spoil banks of GIWW and Freshwater Bayou
Merm	Shoreline Prot.	6b1	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b2	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b3	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Chenier Rest.	416	Chenier restoration: Grand Chenier ridge
Merm	Chenier Rest.	509c	Chenier restoration: Bill Ridge

Merm	Chenier Rest.	509d	Chenier restoration: Cheniere au Tigre
Merm	Chenier Rest.	510d	Chenier restoration: Front Ridge

FISH AND WILDLIFE CONCERNS IN THE PROJECT AREA

Major fish and wildlife resource concerns in the study area include ecosystem-wide hydrologic alterations associated with construction of major navigation channels within the study area and the resulting loss of coastal marsh and the conversion of fresher marshes to more saline habitats. Marsh loss due to shoreline erosion along the Gulf of Mexico is also a problem. The Service is also concerned with water-quality degradation from agricultural and urban run-off, and industrial discharges, into upper Calcasieu Basin waterbodies. Forested areas that once provided habitat for neotropical migrants have suffered extensive losses and continue to be lost to development and sea level rise and subsidence.

The coastal marshes of the Calcasieu-Sabine Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture, as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. Aside from being a key waterfowl wintering area, the Chenier Plain provides important year round habitat for over 90 % of the continental population of mottled ducks and serves as a key breeding area for whistling ducks. The goal of the NAWMP, Chenier Plain Initiative is to provide wintering and migration habitat for significant numbers of dabbling ducks, diving ducks, and geese (especially lesser snow and greater white-fronted), as well as year-round

habitat for mottled ducks. Because wintering waterfowl prefer fresh and intermediate marshes, and because navigation projects have contributed to substantial reductions in those preferred waterfowl habitats, measures to reduce salinity levels would have a positive impact of waterfowl habitat quantity, quality, and usage.

To counter saltwater intrusion effects resulting from the construction and enlargement of the Calcasieu Ship Channel, and to restore former low-salinity habitats, the Fish and Wildlife Service installed three water control structures on Sabine National Wildlife Refuge (in 1981) to regulate saltwater intrusion entering marshes west of Calcasieu Lake. Similarly, the U.S. Department of Agriculture's Cameron-Creole Watershed East Cove Unit project (completed in 1989) was constructed to regulate water levels and reduce saltwater intrusion impacts in the fresh and intermediate marsh habitats in the marshes east of Calcasieu Lake. Operation of these water control structures to rectify ecosystem alterations may at times interrupt ingress and egress of estuarine-dependent fish and shellfish, resulting in unintended fisheries impacts. The proposed Cameron Creole Spillway Structure (measure 74a) would provide additional capacity to discharge water during

periods of excessive rainfall or to evacuate storm surges. Depending upon its operation, the spillway could also be used to temporarily enhance fisheries egress during periods of special needs.

Concerns exist that a future break of the eroding Gulf of Mexico shoreline into deteriorating interior marshes would create a new tidal pass, and would result in harmful salinity increases within interior marshes. Depending upon the location of such shoreline breaches, the resulting impacts could have ecosystem scale impacts. To avoid such impacts, shoreline protection and marsh creation measures have been proposed in strategic locations where such scenarios appear more likely.

Water quality impacts associated with urban and agriculture runoff are ubiquitous concerns that are difficult to address. However, designing all intercepted drainage pump stations to discharge into wetlands may provide some reduction of those impacts.

More serious water quality problems exist in the upper Calcasieu estuary where industrial discharges have resulted in the contamination of upper basin marshes and waterbottoms with dioxins, polychlorinated biphenyls and heavy metals. Should non-structural berm construction activities occur in those environments, those contaminants might be resuspended thereby allowing tidal action and rainfall runoff to then distribute the contaminants to other portions of the system.

Study area chenier ridges were historically forested. Residential and agricultural development has resulted in the clearing of most of the formerly forested areas. Mining of sand has also resulted in additional impacts to the chenier forests and to the chenier landforms. In addition to impeding storm surges, forested cheniers provide important stopover habitat for trans-Gulf neotropical migratory songbirds, many of which have experienced population declines in recent decades.

EVALUATION METHODOLOGY

Hundreds of flood prone structures within the study area were identified. Using aerial imagery, the Service found that five or six of those structures were located adjacent to wetlands. Rather than construct earthen berms around those buildings, flood protection will be provided by constructing sheetpile structures around those buildings. As a result, no impacts to wetlands and associated fish and wildlife habitats would occur as a result of providing non-structural flood protection.

To evaluate the initial array of ecosystem restoration alternatives, several methodologies were used. Wetland acreage benefits associated with the proposed hydrology/salinity control structures were determined using the Wetland Morphology, Eco-Hydrology, and Vegetation models developed for evaluating the 2012 State Master Plan to provide a scientifically sound and defensible way to estimate the comprehensive benefits of those measures (Meselhe et al. 2013, Couvillion et al. 2013, and Visser et al. 2013). Because those measures were already analyzed using these models as part of the 2012 State Master Plan formulation, those results were used to screen proposed hydrology/salinity control (H&S) measures. In general, the H&S measures carried forward in the study were those that had larger-scale benefits, i.e., those that helped maintain greater than 500 net acres as determined by the Master Plan models.

For measures having a smaller area of impact, and for measures not expected to affect hydrologic processes, a contractor utilized the Wetland Value Assessment (WVA) methodology to determine benefits for ecosystem restoration measures (benefits in Average Annual Habitat Units [AAHUs]). In addition to AAHUs, the WVA methodology also allows for the calculation of net wetland acreage benefits at the end of the project's 50-year life (future with project acreage minus future without project acreage). Net acres for marsh creation measures were determined using typical spreadsheet methods and standard assumptions (created marshes lost at 50 percent of the background rate). Shoreline protection net acreage was also determined using spreadsheet methods and the assumption that Gulf shoreline protection features reduced background loss rate 50 percent while interior protection features reduced loss rates 100 percent. The design and operation of the proposed Cameron-Creole Watershed Spillway measure (measure 47a) have yet to be finalized, hence, the benefits for that measure remain uncertain.

POTENTIAL SIGNIFICANT IMPACTS

Construction of non-structural protection berms and/or sheetpile protection structures are not expected to result in impacts to wetlands, nor would they provide any benefits to wetlands or associated fish and wildlife resources.

Because of the different scales of measures, types of measures, and marsh loss processes involved, ecosystem restoration alternatives were evaluated using several different methodologies. Net wetland acreage (future with project acres minus future without project acres at the end of the 50-year project life) was summed using those methodologies (Table 5). Those net acreage values have been used as the benefit metric to compute the cost per benefit values (i.e., cost per year 50 net acreage) used to select the TSP. Estimated net marsh acreage and AAHU benefits of the TSP measures are provided in Table 6.

Table 5. Predicted benefits of ecosystem restoration alternatives.

Alternative	Alternative Description	Acres Created	Acres Nourished	Total Acres	Net Acres	AAHU's
1	**Large Integrated Restoration Across Basins**				**31,960**	**17,898**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				6,614	1,939
	Hydro & Salinity Control				6,126	6,695
	Chenier Reforestation			1,413	1,413	538
2	**Moderate Integrated Restoration**				**28,077**	**14,905**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				7,997	5,892
	Chenier Reforestation			1,413	1,413	538
3	**Moderate Integrated Restoration w/ Gum Cove**				**21,849**	**14,223**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				1,769	5,210
	Chenier Reforestation			1,413	1,413	538
4	**Entry Salinity Control Focus**				**20,577**	**9,785**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				9,136	4,785
	Chenier Reforestation			1,413	1,413	538
5	**Interior Perimeter Control Focus**				**12,129**	**5,238**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				688	238
	Chenier Reforestation			1,413	1,413	538
6	**Marsh & Shoreline Focus**				**24,449**	**14,937**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				4,895	1,559
	Hydro & Salinity Control				334	4,114
	Chenier Reforestation			1,413	1,413	538

Table 6. Estimated benefits and costs of TSP measures.

Basin	Category	Feature	Description	Initial Construction Cost	Prelim RE Cost	Net Acres	Net AAHUs
	Marsh Restoration	47a1	Marsh restoration using dredged material south of LA-82, about 4.5 miles west of Grand Chenier. 933 marsh acres would be restored and 88 acres would be nourished from 3M cubic yards of dredged material with one renourishment cycle.	$32,698,038	$720,000	895	272
		47a2	Marsh restoration using dredged material south of LA-82, approximately 4.5 miles west of Grand Chenier. 1,297 marsh acres would be restored and 126 acres would be nourished from 8.8M cubic yards of dredged material with one renourishment cycle.	$73,725,657	$1,006,000	1,218	381
		47c1	Marsh restoration using dredged material south of LA-82, approximately 4.5 miles west of Grand Chenier. 1,304 marsh acres would be restored and 4 acres would be nourished from 8.6M cubic yards of dredged material with one renourishment cycle.	$70,993,097	$925,000	1,135	353
		127c3	Marsh restoration at Pecan Island, west of the Freshwater Bayou Canal and approximately 5 miles north of the Freshwater Bayou locks. 832 marsh acres would be restored and 62 acres would be nourished from 7.3M cubic yards of dredged material with one renourishment cycle.	$84,352,747	$658,000	735	241
		306a1	Rainey marsh restoration at Christian Marsh, east of the Freshwater Bayou Canal and approximately 5 miles north of the Freshwater Bayou locks. 627 marsh acres would be restored and 1,269 acres would be nourished from 8.1M cubic yards of dredged material with one renourishment cycle.	$97,159,850	$1,348,000	743	645
	Shoreline Protection/ Stabilization	6b1	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 11.1 miles of Gulf shore protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore consisting of geotextile fabric and stone built to an 18 ft crest width.	$104,780,685	$0 (Public Lands)	2,140	625
		6b2	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 8.1 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and	$76,571,740	$0	1,583	466

			stone built to an 18 ft crest width.		(Public Lands)		
		6b3	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 7.2 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and stone built to an 18 ft crest width.	$68,096,051	$0 (Public Lands)	1,098	312
		16b	Fortify spoil banks of Freshwater Bayou. Approximately 15.4 miles of rock revetment at three critical locations to prevent shoreline breaching. Rock revetment would be built to +4 ft with a 4 ft crown. Two maintenance lifts will be required.	$67,773,307	$0 (Public Lands)	662	156
	Chenier Reforestation	CR	13 separate chenier locations would be replanted. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated.	$49,523	$747,000	282	96
	Hydrologic/ Salinity Control	74a	Cameron-Creole Spillway. Located at the breach in the levee south of Lambert Bayou this canal, managed with flap-gates culverts built to +2 ft, would act as a drainage manifold. The outfall channel into Calcasieu Lake would rock-lined for scour protection.	$4,328,000	$0 (Public Lands)	(56)	267
	Marsh Restoration	3a1	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the south shore of the GIWW west of the Calcasieu Ship Channel near Black Lake. Restore 599 marsh acres with 5.3M cubic yards of dredged material with one renourishment cycle.	$66,576,486	$430,000	454	191
		3c1	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the eastern rim of Calcasieu Lake and situated within the Cameron-Creole Watershed area. 1,765 marsh acres would be restored and 450 acres would be nourished from 10.2M cubic yards of dredged material with one renourishment cycle.	$117,802,030	$368,000 (Some Public Lands)	1,451	654
		124c	Marsh restoraton at Mud Lake. Located adjacent and north of Highway 82 and east of Mud Lake. 1,908 marsh acres would be restored and 734 acres would be nourished from 11.1M cubic yards of dredged material with one renourishment cycle.	$65,163,555	$1,871,000	1,915	740
		124d	Marsh restoration at Mud Lake. Located west of the Calcasieu Ship Channel and adjacent to the south rim of West Cove. 159 marsh acres would be restored and 448 acres would be nourished from 1.4M cubic yards of dredged material	$13,826,622	$434,000	168	4

			with one renourishment cycle.				
	Shoreline Protection/ Stabilization	5a	Holly Beach Shoreline Stabilization Breakwaters. Construction of 8.7 miles of rock and low action breakwaters and is a continuation of existing breakwaters. Crown elevation of +1.5 ft with a crown width of 30 ft. Two maintenance lifts will be required.	$43,644,018	$0 (Public Lands)	26	56
	Chenier Reforestation	CR	22 separate chenier locations would be replanted. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated.	$196,778	$2,854,000	1,132	442
	TOTALS			$987,738,184	$11,361,000	15,581	5,901

Implementation of the TSP would result in a net marsh gain at the end of the 50-year project life of 14,223 acres (6,762 acres of brackish marsh and 7,461 acres of saline marsh), excluding the measure 74a, the Cameron-Creole Spillway measure. See Table 7.

Table 7. Summary of TSP acreage benefits by habitat type.

Summary of Marsh Creation Benefits							
Measure Number	Basin	Location	Marsh Type	Acres Created	Acres Nourished	Total Acres	Net Benefits (acres)
3a1	Calcasieu	GIWW	Brackish	599	-	599	454
3c1	Calcasieu	SE Calcasieu Lake	Brackish	1,765	450	2,215	1,451
124c	Calcasieu	Mud Lake	Saline	1,908	734	2,642	1,915
124d	Calcasieu	West Cove	Brackish	159	448	607	168
Saline Marsh Total				**1,908**	**734**	**2,642**	**1,915**
Brackish Marsh Total				**2,523**	**898**	**3,421**	**2,073**
Calcasieu Basin Total				**4,431**	**1,632**	**6,063**	**3,988**

Measure Number	Basin	Location	Marsh Type	Acres Created	Acres Nourished	Total Acres	Net Benefits (acres)
47a1	Mermentau	Grand Chenier	Brackish	933	88	1,021	895
47a2	Mermentau	Grand Chenier	Brackish	1,297	126	1,423	1,218
47c1	Mermentau	Grand Chenier	Brackish	1,304	4	1,308	1,135
127c3	Mermentau	Freshwater Bayou	Brackish	832	62	894	735
306a1	Mermentau	Freshwater Bayou	Brackish	627	1,269	1,896	743
Brackish Marsh Total				**4,993**	**1,549**	**6,542**	**4,726**
Calcasieu & Mermentau Brackish Marsh Creation Total				**7,516**	**2,447**	**9,963**	**6,799**
Calcasieu & Mermentau Saline Marsh Creation Total				**1,908**	**734**	**2,642**	**1,915**
Calcasieu & Mermentau All Marsh Creation Total				**9,424**	**3,181**	**12,605**	**8,714**

Summary of Shoreline Protection Benefits				
Measure Number	Basin	Location	Marsh Type	Net Benefits (acres)
5a	Calcasieu	Holly Beach	Saline	26
6b1	Mermentau	Rockefeller Refuge	Saline	2,140
6b2	Mermentau	Rockefeller Refuge	Saline	1,583
6b3	Mermentau	Rockefeller Refuge	Saline	1,098
16b	Mermentau	Freshwater Bayou	Brackish	662
Gulf of Mexico Saline Marsh Total				**4,847**
Freshwater Bayou Brackish Marsh Total				**662**
Total Shoreline Protection Total				**5,509**

Summary of Hydrologic & Salinity Control Measure Benefits				
Measure Number	Basin	Location	Marsh Type	Net Benefits (acres)
74a	Calcasieu	Cameron-Creole Spilllway	BR & SAL	-56

Summary of Chenier Reforestation Benefits		
Measure Number	Basin	Net Benefits (acres)
	Calcasieu	1,132
	Mermentau	282
Chenier Reforestation Total		**1,414**

The TSP measures would not only restore productive fish and wildlife habitat, but because of their strategic locations, those measures may also provide unquantified indirect protection benefits to

adjacent marshes and shallow open water habitats. Additionally, the chenier reforestation measures would restore 1,414 acres of forested chenier habitat. These reforestation measures would substantially increase the acreage of critically important stop-over habitat for trans-Gulf migrating neotropical songbirds, many of which have experienced recent population declines. The proposed marsh creation, shoreline protection and chenier reforestation measures, would also serve to dampen storm surges and protect communities located north of the coastal marshes.

FISH AND WILDLIFE CONSERVATION MEASURES

The President's Council on Environmental Quality defined the term mitigation in the National environmental Policy Act regulations to include:

a) avoiding the impacts altogether by not taking a certain action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impacts by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action; and,
e) compensation for the impacts by replacing or providing substitute resources or environments.

The Service's mitigation policy (Federal Register, Volume 46, Number 15, pages 7656-7663, January 23, 1991) provides guidance to help ensure that the level of mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high-value habitats which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called in-kind mitigation. The mitigation planning goals and associated Service recommendations should be based on the four categories, as shown in Table 8.

Table 8. U. S. Fish and Wildlife Service Resource Categories.

FWS Resource Categories
Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.
Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.
Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.
Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Bottomland hardwood forests, bald cypress swamps, and coastal marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Therefore, the Service recommends that unavoidable losses of those habitats should be compensated via in-kind replacement.

Based on current project plans, there would be no adverse impacts to the above-mentioned aquatic resources of national importance and hence, no need to mitigate for adverse impacts. The proposed ecosystem restoration measures would instead, increase the quantity of those valuable habitats.

SERVICE POSITION AND RECOMMENDATIONS

Although the proposed ecosystem restoration measures will provide a substantial benefit to wetlands and associated fish and wildlife resources, aspects of those measures can nevertheless have some unintended adverse impacts to adjoining wetlands and/or fish and wildlife resources. The recommendations provided below address ways to avoid such unintended impacts and to improve fish and wildlife habitat quality in and adjacent to those restoration areas. Therefore, the Service supports implementation of the TSP provided the following recommendations are included as part of the plan.

Because submerged aquatic vegetation provides food for migratory waterfowl, and provides high quality nursery habitat for estuarine dependent fisheries (Castellanos and Rozas 2001, and Kanouse et al. 2006), the open water areas targeted for marsh creation measures should avoid areas of dense submerged aquatic vegetation to the greatest degree possible.

Marsh Creation south of Grand Chenier (measures 47a1, 47a2, and 47c1):

These proposed marsh creation measures would convert over 2,000 acres of existing shallow open water to solid marsh. Because those open water areas provide habitat for waterfowl and estuarine fisheries, we recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries and waterfowl.

Because the slurried fill material will come from the Gulf of Mexico, the salinity of the effluent may be very high. If that water is trapped within adjoining marshes or within the fill areas, evapotranspiration during summer and/or droughts could cause damage to adjoining marsh vegetation and/or reduce vegetative colonization of fill areas. To avoid such impacts, we recommend the engineers ensure that adequate channels exist to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, any ponds or enclosed non-fill areas should have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.

To the greatest degree possible, sediment pumping should be conducted during non-growing season periods to reduce possible salinity impacts on adjoining vegetation. If this would require mobilization and demobilization of the sediment pipeline at the beach crossing during months when piping plover are present, the Service does not believe that this would be a problem given limited extent of that activity, and the other proposed measures to reduce or avoid impacts to plovers.

The proposed pipeline route utilizes an existing north-south canal for much of its length. To pump into eastern and western extremes of the designated fill area, the pipeline route should depart from

that designated route only within the proposed fill area, and should be routed through open water areas, to avoid impacting existing marshes.

Marsh Creation along Freshwater Bayou Canal (measures 127c3 and 306a1):

The proposed fill areas are strategically located adjacent to Freshwater Bayou Canal to isolate the canal from interior marshes, to preclude canal related hydrology impacts from impacting interior marshes and waters. Currently, the plans would have the fill areas drain into interior marshes away from Freshwater Bayou Canal. Because the slurried sediment will be obtained from the near shore Gulf of Mexico, the adjacent intermediate marshes and open water areas might be harmed by the saltwater effluent draining from the fill areas. To minimize that impact, the Service recommends that the effluent be drained into Freshwater Bayou Canal and not the interior marshes. After construction, dewatering, and saltwater drainage from the fill areas has been completed, those drainage routes should be plugged and drainage of the fill areas should be redirected into interior marshes.

If a containment dike is constructed adjacent to the Freshwater Bayou Canal, the Service would recommend that it not be degraded after construction so that it can help to maintain the desired hydrologic isolation of the canal from the interior marshes.

Marsh Creation near Mud Lake (measures 124c and 124d):

Measure 124c would convert over 1,900 acres of existing shallow open water to solid marsh. Because those open water areas provide habitat for waterfowl and estuarine fisheries, we recommend that some of those open water areas should not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries, waterfowl, and other wildlife.

Because the slurried fill material will come from the Gulf of Mexico, the salinity of the effluent may be very high. If that water is trapped within adjoining marshes or within the fill areas, evapotranspiration during summer and/or droughts could cause damage to adjoining marsh vegetation and/or reduce vegetative colonization of fill areas. To avoid such impacts, we recommend the engineers ensure that adequate channels exist to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, any ponds or enclosed non-fill areas should have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.

The proposed containment dikes along the western and southeastern fill area boundaries may block existing drainage routes for marshes adjacent to the fill area. Should construction of containment dikes create unintentional impoundments, evapotranspiration may increase the salinity of effluent water discharged into those drainage-impaired marshes during the summer and/or droughts. To avoid potential saltwater impacts and impaired drainage impacts, we recommend weir boxes along those sections of dike be eliminated unless the presence of unimpeded drainage routes can be documented.

Measure 124d would create approximately 149 acres of marsh along the southern edge of West Cove. Because of oil field board roads located south of the proposed fill area, the fill area and marshes south of the fill area must drain northward via several small canals, into West Cove. To prevent ponding impacts to marshes south of the fill area, we recommend the designs for the containment dikes should avoid closing both of those canals.

Cameron-Creole Spillway (measure74a):

The stated design of this structure differs substantially from that found in the 2012 Louisiana Comprehensive Master Plan for a Sustainable Coast (Master Plan). The Service would prefer a design that would allow for greater operational flexibility than the proposed spillway which would have an invert elevation of +2.0 ft NAVD1988. Although the Service supports the Master Plan concept for this measure, details regarding design and operation of this measure are not yet sufficient to authorize this measure under this study. According to staff working to determine benefits (Ken Duffy email correspondence Feb. 2015), the modeling methods used to assess this measure were not sufficient to capture anticipated flood reduction benefits. Consequently, the Service recommends that an independent feasibility assessment of this feature be conducted and that the design should include lower invert elevations and provide greater operational flexibility than that described under this study. Such a design may also provide more benefits if it could be used to discharge excess water when stages are less than +2.0 feet NAVD1988.

The proposed ecosystem restoration measures will create and protect areas of strategically important marshes. However, implementation of some restoration measures could result in some minor adverse impacts. To avoid and/or reduce those project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Service provides the following general recommendations:

1. To the greatest degree practical, borrow pits for construction of marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Borrow pit construction should also avoid the following:
    a. avoid inducing wave refraction/diffraction erosion of existing shorelines
    b. avoid inducing slope failure of existing shorelines
    c. avoid submerged aquatic vegetation
    d. avoid increased saltwater intrusion
    e. avoid excessive disturbance to area water bottoms
    f. avoid inducing hypoxia

2. Marsh creation measures should avoid, to the degree practical, areas of dense submerged aquatic vegetation.

3. The Corps should monitor ecosystem restoration features to document the degree of success achieved. We recommend the Service and other interested natural resource agencies be included in developing those monitoring criteria and in the review of subsequent monitoring information and reports.

4. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

5. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the

Refuge Manager of the Southwest Louisiana Refuge Complex. We recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

6. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

7. We recommend the Corps continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, threatened or endangered species, or species that may be listed in the future.

8. We recommend the Corps coordinate with the Service and other interested natural resource agencies when developing detailed plans regarding restoration measures, especially during the Preliminary Engineering and Design Phase (PED) and construction phase, for measures where specific recommendations have been provided below.

9. To the greatest degree possible, sediment pumping should be conducted during non-growing season periods to reduce possible salinity impacts on adjoining vegetation.

Service recommendations regarding specific ecosystem restoration measures are provided below:

10. Marsh creation measures south of Grand Chenier (47a1, 47a2, and 47c1)
    a. Combined, these measures would convert over 2,000 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries, waterfowl, and other wildlife.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.
    c. To pump into eastern and western extremes of the designated fill area, the pipeline route should depart from that designated route only within the proposed fill area, and should be routed through unvegetated open water areas, to avoid impacting existing marshes.

11. Marsh creation along Freshwater Bayou Canal (measures 127c3 and 306a1)
    a. To avoid saltwater effluent impacts, we recommend the effluent be drained toward Freshwater Bayou Canal and not into the interior marshes. After construction, once saltwater drainage from the fill areas has been completed, those drainage routes should be plugged and drainage of the fill areas should be redirected into interior marshes.

b. If a containment dike is constructed adjacent to the Freshwater Bayou Canal, the Service recommends that it not be degraded after construction so that it can help to maintain the desired hydrologic isolation of the interior marshes from the canal.

12. Marsh creation near Mud Lake (measure 124c)
    a. This measure would convert over 1,900 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries and waterfowl.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.
    c. The proposed containment dikes along the western and southeastern fill area boundaries may block existing drainage routes for marshes adjacent to the fill area. To avoid potential saltwater entrapment impacts and impaired drainage impacts, we recommend weir boxes along those sections of dike be eliminated unless the presence of unimpeded drainage routes can be documented.

13. Marsh creation near West Cove (measure 124d)
    a. To prevent ponding impacts and saltwater entrapment impacts to marshes south of the fill area, we recommend the containment dike designs avoid closing both canals that provide drainage for the fill area and adjacent marshes.

14. Cameron-Creole Spillway (measure74a)

    The Service recommends that an independent feasibility assessment of this feature be conducted and that the design include lower invert elevations and should provide greater operational flexibility than that described under this study. Such a design may also provide more benefits if it could be used to discharge excess water when stages are less than +2.0 feet NAVD1988.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Lafayette, Louisiana 70506

December 3, 2013

Colonel Richard L. Hansen
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Hansen:

Please reference the ongoing Southwest Coastal Louisiana Feasibility Study currently being finalized by the New Orleans District Corps of Engineers (Corps). The Fish and Wildlife Service (FWS) provided you with a draft Coordination Act Report (CAR) dated November 2013. After we submitted our draft CAR, the Tentatively Selected Plan (TSP) was modified to remove all storm surge protection levees from the array of measures designed to provide storm surge protection for study area communities. Consequently, the Service is providing this Supplemental CAR to address this change and update our recommendations. This supplemental report is submitted in partial fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Neither this Supplemental Report, nor our November 2013 draft CAR constitutes the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This Supplemental CAR has been provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Their comments on these reports will be incorporated into our final report.

On November 26, 2013, my staff was informed that the Corps had decided to remove all structural protection levee features from the TSP. This is the third change to the TSP that has occurred since the Service began preparing our draft CAR. Not only have these changes required additional time on the part of our staff, but these changes reveal that the Corps' new planning method has resulted in the identification of a TSP before all the necessary information was available. Moreover, the Service is concerned that in the haste to proceed rapidly through the planning process, this new project planning method may result in the rejection of some alternatives and the selection of others without sufficient information, including details on proposed measures which are needed to understand and quantify the environmental benefits and impacts. Therefore, we request that our concerns about this new method be presented to the appropriate policy makers for their consideration.

In our November 2013 draft CAR, the Service identified a number of planning deficiencies with

the proposed storm surge protection levees and the inability to properly assess their associated impacts to fish and wildlife. Now that the TSP has been modified to eliminate those proposed levees, the Service hereby updates the recommendations contained in our November 2013 draft CAR to revoke all those recommendations (i.e. recommendations 1 through 5) that reference the proposed storm surge protection levees. All the remaining recommendations and comments remain valid and should be addressed by the Corps to fulfil the requirements of the Fish and Wildlife Coordination Act.

Thank you for the opportunity to update our comments. The above findings and recommendations do not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act. Please contact Mr. Ronny Paille of this office (337/291-3117) if you require additional information.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Services Office

cc: EPA, Dallas, TX
NMFS, Baton Rouge, LA
Southwest Louisiana National Wildlife Refuges Complex, Bell City, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
LA Office of Coastal Protection and Restoration, Baton Rouge, LA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506
November 5, 2013

Colonel Richard L. Hansen
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Hansen:

Attached is the Draft Fish and Wildlife Coordination Act Report on the tentatively selected plan for the Southwest Coastal Louisiana Feasibility Study, Louisiana. That study is evaluating alternatives for providing hurricane protection and storm damage reduction and related purposes in Cameron, Calcasieu, and Vermilion Parishes.

This draft report is transmitted under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is being coordinated with the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Comments by those agencies will be incorporated to our final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Ronny Paille of this office at 337/291-3117.

Sincerely,

Jeffrey D. Weller
Supervisor
Louisiana Ecological Field Office

Attachment
cc: SW Louisiana Refuges, Bell City, LA
NMFS, Baton Rouge, LA
EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
OCPR, Baton Rouge, LA

Southwest Coastal Louisiana Feasibility Study

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY

RONALD PAILLE
SENIOR FISH AND WILDLIFE BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

NOVEMBER 2013

The Corps of Engineers (Corps) was requested to conduct the Southwest Coastal Louisiana Feasibility Study (SWLA Study) via Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 110 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."

Numerous measures to provide storm damage reduction and ecosystem restoration measures were evaluated within the study area. Those measures included construction of levees designed to provide hurricane storm surge protection (including the armored 12-foot levee described above), protection and restoration of coastal wetlands and unique natural ecosystem features (such as cheniers), construction of shoreline protection projects (for navigation canals, interior lakes and bays, and the Gulf of Mexico), and implementation of non-structural protection measures such as structure relocations and buyouts.

The initial list of proposed project measures was derived from existing large-scale coastal protection and ecosystem restoration plans (e.g., the Louisiana Coastal Protection and Restoration Plan [LACPR], the Louisiana Coastal Area Ecosystem Restoration Study Report [LCA], and the Louisiana's Comprehensive Master Plan for a Sustainable Coast [State Master Plan 2012]), public comments received during the project scoping process, and recommendations provided by local representatives and natural resource agencies during the initial planning phase of the project. The initial list of potential project measures was reduced to a more focused and achievable final list of measures based on criteria that were approved by an interagency project delivery team.

The final list of measures was assembled into 6 possible protection levee alternatives and 6 ecosystem restoration alternatives, all of which were evaluated for cost effectiveness. The Lake Charles Eastbank levee, together with non-structural protection measures in select locations, was chosen as the protection measures for inclusion in the Tentatively Selected Plan (TSP). Restoration Alternative 4 (Entry Salinity Control Alternative) was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass and Calcasieu Ship Channel salinity control structures (measures 48 and 7, respectively), and to add the shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6B1, 6B2, and 6B3).

In addition to providing hurricane storm surge protection in developed portions of the project area, implementation of the TSP would restore, enhance, and protect substantial areas of coastal marsh and forested chenier habitat. Because many design details regarding the proposed surge protection levees are yet to be developed, additional planning work must be conducted before impacts can be fully determined. Similarly, the proposed ecosystem restoration measures need additional planning work and interagency coordination to finalize estimated benefits and impacts

with any degree of certainty. To complete needed planning of project features, to reduce and avoid project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Fish and Wildlife Service provides the following recommendations:

1. The Corps should conduct further planning of the proposed protection levee to reduce and avoid impacts to wetlands and forest habitats. Additional levee planning work should also include the development of measures to avoid interrupted drainage impacts in a manner that reduces or avoids impacts to wetlands and forested habitats. The additional planning work should be coordinated with the Service and other interested natural resource agencies. Any pump stations needed for drainage of the protected area should be designed to discharge into wetlands to reduce adverse effects of discharging runoff directly into open water bodies.

2. The Corps should also determine where levee borrow material will be obtained.

3. To the greatest degree practical, borrow pits for construction of proposed levee and marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives. Borrow pit construction should also avoid the following:
   a. avoid inducing wave refraction/diffraction erosion of existing shorelines
   b. avoid inducing slope failure of existing shorelines
   c. avoid submerged aquatic vegetation
   d. avoid increased saltwater intrusion
   e. avoid excessive disturbance to area water bottoms
   f. avoid inducing hypoxia

4. Once levee planning has been completed, the Corps should revise estimates of direct and indirect impacts to wetlands and forested habitats, including impacts associated with acquisition of borrow material. That work should be conducted in cooperation with the Service and other interested natural resource agencies.

5. The Corps should conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds National Oceanic and Atmospheric Administration screening levels, then alternative locations should be considered, or, explanation of the containment methods that would allow levee construction should be provided to the Service and other interested natural resource agencies.

6. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those features to

document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports. For mitigation features, the Service also recommends that all interested natural resource agencies be involved in the planning of project features, monitoring plans, development of success criteria, and adaptive management plans. In addition, all mitigation plans should address the 12 mitigation requirements in Appendix A.

7. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

8. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex; furthermore, all activities on NWRs must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

9. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

10. The Corps should continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, and threatened or endangered species that may be listed in the future.

Given that the design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Fish and Wildlife Coordination Act (FWCA)(48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) responsibilities at this time. Therefore, this draft report is presented in partial fulfillment of that act and does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the FWCA. To complete those assessments, we will require additional funding during the project's pre-construction engineering and design phase. Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the extent of remaining work and the nature and complexity of issues associated with the remaining planning/design issues.

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INTRODUCTION

The Southwest Coastal Louisiana Feasibility Study (SWLA Study) was authorized by Resolution Docket 2747 adopted on December 7, 2005, by the U.S. House of Representatives Committee on Transportation and Infrastructure. That Docket specifically requested the Secretary of the Army, in accordance with section 110 of the River and Harbors Act, to "survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway." Investigation of area ecosystem restoration measures was authorized via the Water Resources Development Act of 2007 (Title VII, Louisiana Coastal Area program, Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study).

The study area is located within Louisiana's Chenier Plain which is characterized by lakes, bayous, wetlands, cheniers, and coastal beaches. The Mermentau Basin and the Calcasieu/Sabine Basin are the two major hydrologic basins within the Chenier Plain. There are numerous communities within the study area including Abbeville, Cameron, Delcambre, Erath, Gueydan, Hackberry, Kaplan, Lake Arthur, Lake Charles, and Sulphur. Although the approved Southwest Coastal Louisiana Feasibility Study authorization is restricted to Calcasieu, Cameron, and Vermilion Parishes, several project alternatives occurring beyond those parishes were considered because of their anticipated effects on the project area.

Numerous project measures and groups of measures were evaluated. Surge protection alternatives included alternative levee alignments (including the armored 12-foot levee described above), as well as non-structural alternatives. Ecosystem restoration alternatives included various combinations of salinity control/reduction measures, strategic marsh creation measures, strategically located shoreline protection measures, and restoration/reforestation of cheniers.

This report provides a preliminary analysis of the impacts of the Tentatively Selected Plan (TSP) on fish and wildlife resources. The TSP is a combination of structural and non-structural storm surge protection measures, and an array of different types of ecosystem restoration features. The Service conducted a cursory assessment of direct impacts associated with construction of proposed levee alternatives. Because details regarding drainage of the protected area have not yet been developed, this impact assessment is considered preliminary and likely to change. The analysis of ecosystem restoration benefits was conducted by a contracted consulting firm. Because planning details for many of those measures have not yet been developed, and because specifics of those measures have not been made available to the Service and interested natural resource agencies, the Service considers the benefit and impact assessments as preliminary. Since information needed to fully assess project benefits and impacts is not yet available, this draft report is submitted in partial fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This draft report has been provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service. Their comments on this report will be incorporated into our final

report.

DESCRIPTION OF STUDY AREA

The study area, which encompasses Calcasieu, Cameron, and Vermilion Parishes, is typically termed the Chenier Plain of Louisiana. The Chenier Plain encompasses the southwestern Louisiana coastal zone from Freshwater Bayou west of Vermilion Bay to Sabine Lake near the Texas-Louisiana border. Cheniers are relict beach ridges that generally parallel the Gulf shoreline, and derive their name from the Cajun word "chene" meaning oak, because oaks are the dominant tree species on the crests of the higher chenier ridges (Penland et al. 1989). Because chenier elevations are higher than the surrounding marshes, they often serve as hydrologic barriers, with varying levels of effectiveness, between saline marshes to the south and freshwater marshes to the north (Corps 2008). The two hydrologic basins encompassed by the study area are the Mermentau and the Calcasieu-Sabine Basins (Figure 1).

Mermentau Basin

The Mermentau River Basin is located between Freshwater Bayou Canal to the east and that segment of Louisiana Highway 27 east of Calcasieu Lake. The Basin encompasses an area of about 4.2 million acres and contains productive agricultural lands and a variety of natural environments (Corps 1999). The Mermentau Basin is divided into two sub-basins, the Lakes and Chenier Subbasins (Figure 1), both of which occur within the feasibility study boundary. North of the Lakes Sub-basin lies uplands beyond the study boundary and covers an area of 3,683 mi^2 of predominantly agricultural land (Gammill et al. 2002). The principal agricultural products in this region are rice and crawfish, which both require ample supplies of fresh water typically provided via the Corps' management of the Mermentau Basin Project (Corps 1999).

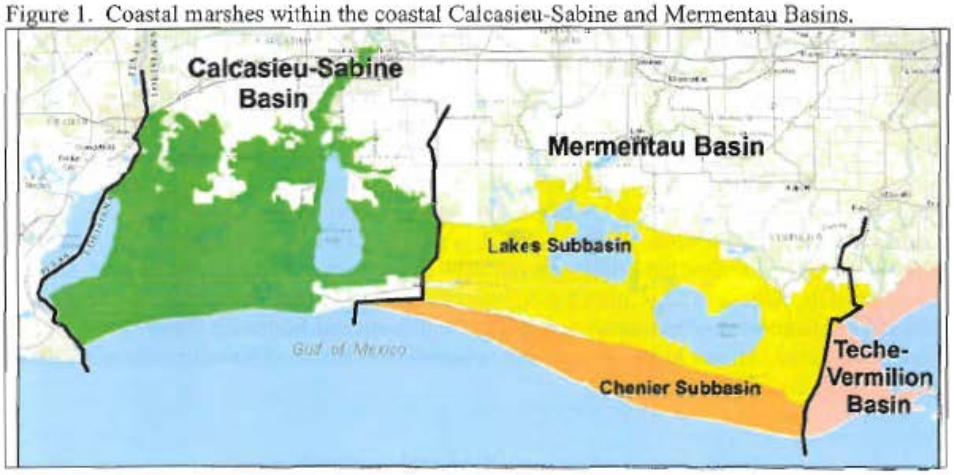
The Lakes Sub-basin is located roughly between the Gulf Intracoastal Waterway (GIWW) and Louisiana Highway 82, and historically functioned as a low-salinity brackish estuary (Corps 2008). Construction of navigation channels, locks, and water control structures has altered the historical north-south river and tidal-driven hydrology and shifted it to an east-west system that drains through the GIWW. The Corps' locks and water control structures that are located along the perimeter of the Lakes Sub-basin regulate both salinity and water level so that the Lakes Sub-basin now functions more as a freshwater reservoir and less as the low-salinity estuary that it was prior to these alterations (Gammill et al. 2002). The demand for a reliable fresh water supply for agricultural use was the primary reason for the development of the Mermentau Basin Project (Corps 1999).

The Mermentau Basin Project involves the operation and management of five navigation locks and control structures: (1) the Calcasieu Lock located on the Gulf Intracoastal Waterway (GIWW) near the intersection of Louisiana Highway 384, (2) the Leland Bowman Lock situated on the GIWW near Intracoastal City, (3) the Freshwater Bayou Lock located on the Freshwater Bayou Canal approximately one mile north of the Gulf of Mexico, (4) the Catfish Point Control Structure located on the southwest side of the basin where the Mermentau River exits Grand Lake, and (5) the Schooner Bayou Control Structure located on the east side of the basin in the

old Intracoastal Waterway between Freshwater Bayou and White Lake. The target water level inside the basin is 2.0 feet above mean low Gulf and the five Corps structures are operated in concert to maintain this level and preclude saltwater intrusion (Corps 1999).

The Chenier Sub-basin is located south of the Lakes Sub-basin, between Louisiana Highway 82 and the Gulf of Mexico. Approximately one-third of this sub-basin is comprised of the State-owned and operated Rockefeller Wildlife Refuge. The Chenier Sub-basin is characterized by tidally influenced salt marshes, though hydrology throughout much of the area is managed through impoundments that range in size from hundreds to thousands of acres. The purpose of that management is to control salinity in order to reduce wetland losses and/or sustain recreational and agricultural endeavors (Corps 2008).

Figure 1. Coastal marshes within the coastal Calcasieu-Sabine and Mermentau Basins.



Calcasieu-Sabine Basin

The Calcasieu-Sabine Basin extends from Sabine Lake and River eastward to the Louisiana Highway 27 segment east of Calcasieu Lake. The Calcasieu-Sabine Basin consists of two semi-distinct sub-basins, the Calcasieu River Basin and the Sabine River Basin. When the GIWW was built in the 1920s, it breached the Gum Cove Ridge which had historically formed a partial north-to-south oriented hydrologic barrier between the Calcasieu and Sabine Lake systems. That breach, in combination with several smaller canals, now facilitates water exchange between the sub-basins, and has exacerbated saltwater intrusion problems in the marshes adjacent to the GIWW. The typical water-movement scenario is that south winds push salt water into Calcasieu Lake, westward through the GIWW, and across the Gum Cove Ridge breach. This water is eventually swept down the Sabine River and into Sabine Lake. Currently, salt water that is pushed into Calcasieu Lake remains there because there is little back flow from the Lake. Without the Gum Cove Ridge breach, the current semi-circular flow patterns would not exist, and lake levels would rise more modestly, thus reducing the volume of seawater entering Calcasieu Lake (Lopez et al. 2008).

The widening and deepening (to -40 feet deep by 400 feet wide) of the Calcasieu River and Pass Ship navigation channel (referred to as the Calcasieu Ship Channel [CSC]), as well as the removal of the channel mouth bar, has increased saltwater and tidal intrusion into the Calcasieu-Sabine Basin, resulting in marsh loss, tidal export of organic marsh substrate, and an overall shift to more saline habitats in the region. In 1968, the Corps completed construction of the Calcasieu River Saltwater Barrier on the Calcasieu River north of the City of Lake Charles. This barrier minimizes the flow of salt water into the upper reaches of the Calcasieu River to protect agricultural water supplies (Gammill et al. 2002). The Corps-maintained Calcasieu Lock, located east of the CSC on the GIWW near its intersection with Louisiana Highway 384, is operated to prevent saltwater intrusion into the Mermentau Basin as part of the Corps' Mermentau Basin Project.

The Sabine River has a drainage area of approximately 9,325 square miles and is the dominant influence across most of the Calcasieu-Sabine Basin in moderating salinity and tidal fluctuations. Sabine Pass was first dredged for navigation in 1880, and has been progressively deepened to its present depth of -40 feet. The Sabine-Neches Canal (later to become the Sabine-Neches Waterway) was constructed in the early 1900s. That channel not only facilitates saltwater intrusion into the area, it also funnels freshwater inflows more directly to the gulf, largely bypassing the adjacent marshes in Louisiana and Texas. A feasibility analysis has been conducted to deepen and widen the Sabine-Neches Ship Channel, but construction has yet to be initiated due to lack of funding. Saltwater intrusion in the Neches River has, in the past, necessitated the release of large quantities of water from the Sam Rayburn Reservoir to prevent saltwater contamination of industrial, agricultural, and municipal freshwater supply for Beaumont, Texas. To remedy those problems, a permanent saltwater barrier in the Neches River at Beaumont was constructed in 2003.

FISH AND WILDLIFE RESOURCE CONDITIONS

Existing Fish and Wildlife Habitats

The Chenier Plain consists of open water ponds and lakes, cheniers, gulf shorelines, and freshwater, intermediate, brackish, and saline marsh (Giron and Perez 2009). Marshes within Louisiana's Chenier Plain began forming about 3,000-4,000 years ago during periods when the Mississippi River occupied a more westerly course (Gosselink et al.1979). Expansive mud flats were created by large quantities of Mississippi River sediment that periodically accreted along the Gulf shoreline. When the river would shift to a more easterly location, erosion would rework the gulf shoreline to form beach ridges parallel to shore (Gammill et al. 2002). These ridges, consisting mainly of sand and shell, were typically higher in elevation than surrounding marshes and were colonized by live oaks (*Quercus virginiana*). Early explorers called the ridges "cheniere," a French word meaning "place of oaks" (Kniffen and Hilliard 1988). Over time, a series of Gulf of Mexico shoreline transgressions and regressions caused by periodic shifting of the Mississippi channel from east to west resulted in the shore-parallel ridge and swale topography that dominates Louisiana's Chenier Plain today (Gammill et al. 2002). Despite substantial hydrologic alterations, wetlands of the Chenier Plain continue to support nationally

significant fish and wildlife resources. They provide important habitat for various species of plants, fish and wildlife, and they serve as ground water recharge areas, provide storage areas for storm and flood waters, serve as natural water filtration areas, provide protection from wave action, erosion, and storm damage, and provide various consumptive and non-consumptive recreational opportunities. Predominant habitats and their associated fish and wildlife values are described below.

Forested Habitat

The four major forest types within the study area include swamp, bottomland hardwood, pine-oak forests, and upland chenier forest. Swamps are generally dominated with baldcypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), swamp red maple (*Acer rubrum* var. *drummondii*), and various understory plant species. Coastal swamp forests typically occupy the area between fresh marshes and areas of higher elevation, including the transition zones between bottomland hardwood forests on riverine interdistributary ridges and lower elevation marshes. Healthy cypress swamps occur in fresh water areas experiencing minimal daily tidal action and where the salinity range does not normally exceed 2 parts per thousand (ppt). Salinities of 3 ppt or higher may cause significant stress and mortality of baldcypress. However, short-term exposure to such salinities may be tolerated if it does not penetrate into and persist in the soil (Corps 2009).

Bottomland hardwood forests occur primarily along the floodplains and distributary ridges of the various bayous and rivers within northern portions of the study area. Common tree species include sugarberry (*Celtis laevigata*), water oak (*Quercus nigra*), live oak, nuttall oak (*Quercus nuttallii*), overcup oak (*Quercus lyrata*), bitter pecan (*Carya aquatica*), black willow (*Salix nigra*), American elm (*Ulmus americana*), swamp red maple, box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and baldcypress (Corps 2009).

The suppression of fire within area pine flatwoods has resulted in the conversion of forests to pine-oak forests. These pine-oak forests are generally found on poorly drained flats and depressional areas north of the GIWW and predominantly around the cities of Sulphur and Lake Charles. Common tree species include slash pine (*Pinus elliottii*), longleaf pine (*Pinus palustris*), water oak, laurel oak (*Quercus laurifolia*), sweet bay (*Magnolia virginiana*), sweetgum (*Liquidambar styraciflua*), rough-leaf dogwood (*Cornus drummondii*), and wax myrtle (*Myrica cerifera*). These former pine flatwood communities may also contain a very diverse herbaceous community that can include many state rare species (Corps 2009).

A unique feature of the Chenier Plain is the chenier ridge habitat that formed on abandoned beach ridges. These ancient beaches, composed primarily of sand and shell, were stranded behind prograding shorelines built during periods of sedimentation fed by the Mississippi River. Common tree species on cheniers include live oak, sugarberry, swamp red maple, sweetgum, and water oak. Red mulberry (*Morus rubra*), toothache-tree (*Zanthoxylum clava-herculis*), and sweet acacia (*Acacia farnesiana*) also occur on these ridges (Corps 2009). Cheniers are important storm surge buffers, often serving as hydrologic barriers that limit saltwater intrusion into interior marshes (Corps 2008). Wooded habitats on the cheniers are critically important stopover habitat for neotropical songbirds migrating across the Gulf (Moore and Simons 1992, Moore 1999).

Scrub-Shrub Habitat

Scrub-shrub habitat within the study area often occupies a zone where marshes transition into slightly higher elevation habitats. Scrub shrub habitats are found along bayou ridges and on dredged material embankments, and areas typically bordered by marsh, swamp, or bottomland hardwoods. In saline areas, scrub-shrub communities are dominated by black mangrove (*Avicennia germinans*) on flooded saltmarsh edges, or by marsh elder (*Iva frutescens*) and Eastern baccharis (*Baccharis halimifolia*) on low ridges, bayou banks, and spoil banks and other disturbed areas. Brackish scrub-shrub wetlands are also dominated by eastern baccharis and marsh elder, although wax myrtle (*Morella cerifera*, formerly *Myrica cerifera*) is common on low ridges, bayousides, and spoilbanks as well. Typical scrub-shrub vegetation in intermediate and fresh areas includes elderberry (*Sambucus canadensis*), wax myrtle, buttonbush (*Cephalanthus occidentalis*), rattlebox (*Sesbania drummondii*), Drummond red maple (*Acer rubrum var. drummondii*), Chinese tallow tree (*Sapium sebiferum*), marsh elder, and eastern baccharis. Dwarf palmetto (*Sabal minor*) and prickly pear cactus (*Opuntia spp.*) are common in the understory of Chenier/maritime forest. Yaupon (*Ilex vomitoria*), dwarf palmetto, swamp privet (*Forestiera acuminata*) and Virginia willow (*Itea virginica*) also occur in thickets and the understory of swamps and bottomland hardwood forests (Corps 2009). Those habitats often support a variety of wildlife, depending on local conditions; they provide nesting and feeding sites for wading birds, songbirds and other birds, and wildlife escape cover.

Fresh Marsh

Freshwater marshes are quite heterogeneous, with local species composition governed by frequency and duration of flooding, micro-topography, substrate, current flow and salinity. This marsh type is typically dominated by maidencane, bulltongue, spikerushes, pennywort (*Hydrocotyle* sp.), elephant-ear (*Colocasia esculenta*) and alligatorweed (*Alternanthera philoxeroides*). Other common plants are bullwhip, giant cutgrass (*Zizaniopsis miliacea*), fourchette (*Bidens laevis*) and cattail (*Typha* sp.). Fresh marshes are often very diverse with different species of grasses and broad-leaved annuals waxing and waning throughout the growing season. Chabreck (1972) documented 93 plant species occurring in the fresh marshes of coastal Louisiana. In some areas, fresh marshes consist of nearly pure stands of maidencane. Aquatic plants commonly found in fresh marsh waters are duckweed (*Lemna minor*), coontail (*Ceratophyllum demersum*), Eurasian watermilfoil, southern naiad, water hyacinth (*Eichornia crassipes*), pondweeds (*Potamogeton* spp.), white waterlily (*Nymphaea odorata*), elodea (*Elodea canadensis*), hydrilla (*Hydrilla verticillata*), water celery, water shield (*Brasenia shreberi*), fanwort (*Cabomba caroliniana*), American lotus (*Nelumbo lutea*), and several invasive species of *Salvinia*. Fresh marsh salinity rarely exceeds 2 ppt, with a year-round range of approximately 0.5-1 ppt.

Canal-induced saltwater intrusion has drastically reduced the extent of fresh marsh that historically existed within the Calcasieu-Sabine Basin (Figure 2). However, fresh marsh remains the dominant marsh type within the upper Lakes Sub-basin of the Mermentau Basin (Figure 3).

Figure 2. Marsh types (2007) within the Calcasieu-Sabine Basin.

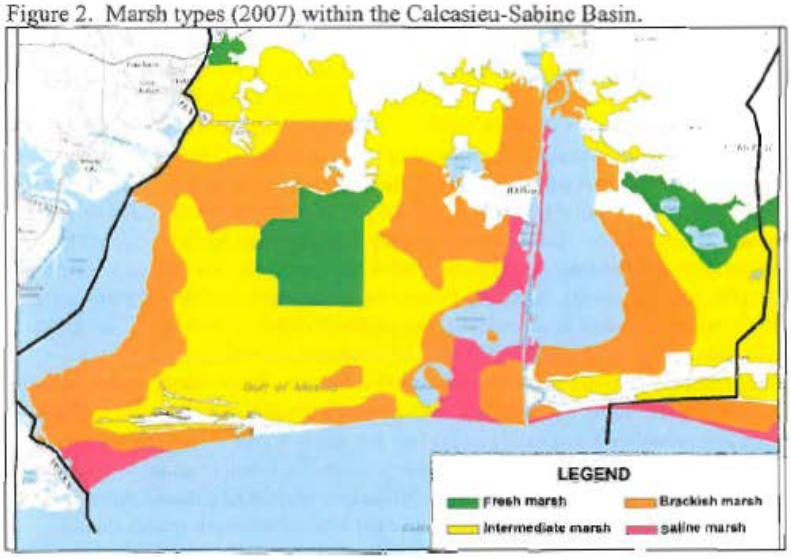
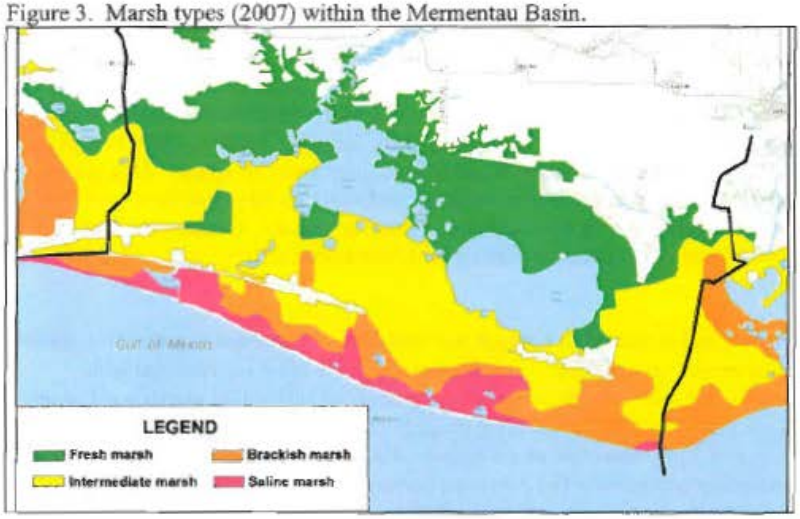


Figure 3. Marsh types (2007) within the Mermentau Basin.



Freshwater marshes support extremely high densities migratory waterfowl and other wildlife. However, because of saltwater intrusion, freshwater marshes have undergone the highest rate of reduction in acreage of any of the marsh type in Louisiana over the past few decades.

Intermediate Marsh

Intermediate marsh may occur when annual salinity averages 3 to 4 ppt; but often intermediate marsh salinities may be fresh for much of the year with higher salinity conditions occurring during the late summer and early fall. Chabreck's (1972) identification of 54 species of plants in intermediate marsh indicates that plant species richness is relatively high. The intermediate marsh can be difficult to identify, as it sometimes may appear less as transitional zone between brackish and fresh marshes. Marshhay cordgrass or bulltongue (*Sagittaria lancifolia*) is usually the dominant or co-dominant species. These are commonly accompanied by three-cornered grass, roseau or common reed (*Phragmites australis*), seashore paspalum (*Paspalum vaginatum*), coastal waterhyssop (*Bacopa monnieri*), bullwhip (*Schoenoplectus californicus* formerly *Scirpus californicus*), Walter's millet (*Echinochloa walteri*), sawgrass (*Cladium jamaicense*), deer pea (*Vigna luteola*), rush (*Eleocharis sp.*), dwarf spikerush (*Eleocharis parvula*), and fragrant flatsedge (*Cyperus odoratus*). Aquatic plant species found in intermediate marsh waters include widgeongrass, Eurasian watermilfoil, water celery, and southern naiad (*Najas guadalupensis*). Intermediate marshes are considered extremely important for many wildlife species, such as alligators and wading birds, and serve as important nursery areas for larval marine organisms. Although still a common natural community type in Louisiana, intermediate marsh appears to be declining in aerial extent, which has been attributed to a shift toward brackish marsh due to increased salinity levels. Visser et al. (2000), expanding on previous studies by Penfound and Hathaway (1938) and Chabreck (1970), classified intermediate marsh in the Chenier Plain as a combination of *Cladium jamaicense* (sawgrass), *Spartina patens* (saltmeadow cordgrass), and *Schoenoplectus californicus* (California bulrush).

Intermediate marsh occurs within the more interior portions of the Calcasieu-Sabine Basin where exposure to saltwater intrusion is lessened by distance from saltwater sources. Intermediate marsh may have an irregular tidal regime, with salinity ranging from 3 to 10 ppt. This marsh type is very important to many species of avian wildlife and supports large numbers of wintering waterfowl. It is also critical nursery habitat to larval marine organisms. Gradual changes in salinity conditions can cause this habitat to shift towards brackish marsh.

Brackish Marsh

Inland from salt marsh, and subjected to reduced tidal influence, is brackish marsh. This marsh type is dominated by marsh-hay cordgrass. Brackish marshes are often interspersed with numerous small ponds and water channels and have experienced substantial marsh breakup and degradation in recent years. Salinity levels often range between 0.5 to 5.0 ppt and average salinity is in the range of 8 ppt, however, much higher salinities may occur periodically. In the brackish marsh, marshhay cordgrass is the dominant herbaceous species. Saltgrass, three-cornered grass (*Schoenoplectus americanus*, formerly *Scirpus olneyi*), smooth cordgrass, black needlerush, and leafy three-square (*Schoenoplectus maritimus* formerly *Scirpus maritimus*) are often co-dominant or common in this zone. It should be noted that some of these species also occur in saline marsh, but the order of dominance differs. Chabreck (1972) identified forty species of plants in brackish marsh. Aquatic plants that commonly occur in brackish marsh waters include widgeon grass, Eurasian watermilfoil (*Myriophyllum spicatum*), water celery (*Vallisneria americana*), and horned pondweed (*Zannichellia palustris*). Visser et al. (2000)

classified brackish marsh in the Chenier Plain as a combination of *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus robustus* (sturdy bulrush).

Brackish marshes occur predominantly along the borders of Calcasieu and Sabine Lakes. Brackish marshes are extremely important as nurseries for fish and shellfish. Wading birds, muskrats and shorebirds are also common in such areas.

Saline Marsh

Salt marshes usually receive regular tidal inundation and occur in the most saline zones along the Gulf of Mexico shoreline and adjacent to the Calcasieu Ship Channel. Smooth cordgrass *(Spartina alterniflora)* is the dominant plant in this marsh type, and often forms near-monotypic stands. Herbaceous vegetation of the saline marsh is typically dominated by smooth cordgrass intermixed with saltgrass (*Distichlis spicata*), marshhay cordgrass, black needlerush (*Juncus roemerianus*), and saltwort (*Batis maritima*). Chabreck (1972) identified 12 species of emergent vegetation typically associated with this marsh type. Within the described marsh zones, many ponds and lakes support submerged and/or floating-leafed aquatic vegetation (SAV). Aquatic vegetation is rare in saline waters along the Louisiana coast (Chabreck, 1972). However, widgeon grass (*Ruppia maritima*) may occur in open water areas of saline marshes bordering on the brackish marsh zone and in saline areas where tidal flow has been decreased by structures or other changes in hydrology. Average salinity is approximately 16 ppt. Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some species like Seaside Sparrows and Clapper Rails are common (Corps 2009). Salinity levels may range from 5.0 to 18 ppt, however, salinities may occasionally be lower or higher.

Saline marsh habitat exists in the project area closest to the Gulf of Mexico beach rim and along the Lower Lake (i.e., river miles (RMs) 5 to 12) and Calcasieu Pass (i.e., RMs 0 to 5) portions of the Calcasieu Ship Channel. Saline marsh is a regularly tidally-flooded habitat having least plant diversity.

Open Water

Small ponds and shallow open water areas associated with each of the above marsh plant communities are scattered throughout the project area. Some of the more defined open water areas include Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake along the ship channel. Black Lake, Browns Lake, and Mud Lake are open water areas occurring west of the ship channel. Willow Lake and Sweet Lake occur east of the ship channel.

Submerged Aquatic Vegetation Habitat

Some protected shallow open water habitats within the project area support submerged aquatic vegetation (SAV). Prior to Hurricane Rita concentrations of SAVs densities up to 80 percent coverage occurred within Cameron Prairie National Wildlife Refuge (NWR) and those concentrations are expected to return (personal communication with NWR personnel 2007). Project area SAV habitats may include areas of widgeon grass, duckweeds, coontail, bladderworts, watermilfoil, hydrilla, mermaidweeds, and pondweeds. As these aquatic plants die, their decomposition by bacteria and fungi contribute to the food web by providing detritus

for many aquatic invertebrates. SAVs are very important to wildlife and are utilized by many duck species.

Developed Lands

Developed areas are located on the higher elevations of the Pleistocene terrace along the GIWW and around the Lake Charles area and are typically well drained. They include agricultural lands and commercial and residential developments. Levees are also included in this category. Levees are frequently mowed, and, as such, provide poor wildlife habitat. Some levees are vegetated with an assortment of scrub/shrub species including marsh elder, eastern baccharis, Chinese tallow tree, common reed, and goldenrod. These higher-elevation areas may provide low-to-moderate-value habitat for terrestrial wildlife, including some migratory bird species.

Existing Fishery Resources

The project-area wetlands and associated shallow waters provide nursery and feeding habitat for recreationally and commercially important estuarine-dependent fishes and shellfishes (e.g., red drum, black drum, Atlantic croaker, spot, sand seatrout, spotted seatrout, southern flounder, Gulf menhaden, striped mullet, blue crab, white shrimp and brown shrimp). Commercial shrimp harvests have been positively correlated with the area of tidal emergent wetlands (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes would likely be adversely impacted by continued losses in estuarine marsh habitat (Turner 1982). Portions of the project area also provide habitat for freshwater fishes that can tolerate low-salinity conditions, including largemouth bass, bluegill, warmouth, gars, freshwater drum, blue catfish and channel catfish.

Salt and brackish marshes serve as nursery areas for myriads of larval and juvenile shrimp, crabs, redfish, seatrout, Gulf menhaden, etc., and greatly enhance the production of marine organisms. Vegetation production rates in estuarine marshes are extremely high, providing an abundance of detritus to support the estuarine food web.

Much of the existing project area-wetlands are subject to permitted structural management that varies from semi-impounded to completely impounded marsh. The majority of the water control structures within the semi-impounded management areas are supposed to be operated to allow ingress and egress of estuarine fishery organisms, especially brown shrimp and white shrimp, except during drawdowns, periods of high salinity, or waterfowl seasons. Unmanaged coastal wetlands are of particular importance due to their relative scarcity within the Calcasieu-Sabine Basin.

Essential Fish Habitat

Estuarine wetlands and associated shallow waters within the project area have been identified as Essential Fish Habitat (EFH) for both postlarval, juvenile and sub-adult stages of brown shrimp, white shrimp, and red drum, as well as the adult stages of those species in the nearshore and offshore reaches. EFH in the nearshore, marine-portion of the project area and in the lower

portions of the estuary has also been designated for the following species and their associated life stages: lane snapper, larvae and juvenile life stages; dog snapper, juvenile life stage; and bonnethead shark, juvenile life stage. EFH requirements vary depending upon species and life stage. Categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), (P.L. 104-297). Estuarine-dependent species such as those listed above also serve as prey for other species managed under the MSFCMA by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species (e.g., billfishes and sharks) managed by the NOAA-Fisheries.

Existing Wildlife Resources

The project area supports an array of productive coastal habitats, dominated by intermediate and brackish marshes and associated shallow estuarine waters. The project-area wetlands and adjacent shallow waters, as well as the chenier ridges, support numerous federal-trust wildlife resources, including migratory birds, threatened and endangered species, and various federal and private land holdings that are held or managed to benefit those species.

The chenier and coastal forest habitats associated with the project area provide nesting habitat for songbirds (e.g., the mockingbird, yellow-billed cuckoo, brown thrasher and northern parula), as well as stopover areas for trans-Gulf migrating songbirds. Other avian species found in project area's forested habitats include the American woodcock, common yellow-shafted flicker, belted kingfisher, and several species of raptors (e.g., red-tailed hawk and red-shouldered hawk). Wading bird colonies containing species such as anhinga, great egret, and great blue heron typically occur in wooded wetland and scrub-shrub habitat.

Mammals associated with the project area forested habitats include game species such as eastern cottontail, swamp rabbit, white-tailed deer, and gray and fox squirrels; commercially important furbearers such as river otter, muskrat, and nutria; and other mammal species such as striped skunk, coyote, nine-banded armadillo, and Virginia opossum. Smaller mammals such as the cotton rat, marsh rice rat, and white-footed mouse serve as forage for both mammalian and avian carnivores.

Reptiles which utilize study-area forested habitats include the ground skink, five-lined skink, green anole, and western ribbon snake, and numerous other species. Some of the amphibians expected to be found in study-area forested habitats including small-mouthed salamander, green treefrog, bullfrog, and southern leopard frog.

Wildlife expected to utilize the study-area estuarine marshes include wading birds (e.g., herons, egrets, ibises, and roseate spoonbills), rails, migratory waterfowl (e.g., green-winged teal, blue-

winged teal, mottled duck, gadwall, American widgeon, and lesser scaup), raptors, and songbirds. Brackish marshes having abundant submerged aquatic vegetation often support large numbers of puddle ducks. Shorebirds utilizing estuarine marshes include killdeer, American avocet, black-necked stilt, American oystercatcher, common snipe, and various other species. Seabirds include white pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. Other nongame birds such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, belted kingfisher, and sedge wren also utilize estuarine marshes.

Estuarine marsh wildlife also includes swamp rabbit, nutria, muskrat, mink, river otter, raccoon, white-tailed deer, and coyote. Reptiles are limited primarily to the American alligator in intermediate and brackish marshes, and the diamond-backed terrapin and gulf salt marsh snake in brackish and saline marshes. Juvenile sea turtles may seasonally utilize bays and saline marsh ponds in the lower Calcasieu Estuary.

Threatened and Endangered Species

Federally listed threatened or endangered species that occur within the study area include the piping plover (*Charadrius melodus*), the whooping crane (*Grus americana*), the West Indian manatee (*Trichechus manatus*), and several species of sea turtles which have also been known to occur in the southern portion of Calcasieu Lake. The red knot (*Calidris canutus rufa*) is proposed for federal listing as a threatened species and the Sprague's pipet (*Anthus spragueii*) is a candidate species for federal listing as a threatened or endangered species

The piping plover, federally listed as a threatened species, as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change; and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent

elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. If implementation of the proposed action has the potential to directly or indirectly affect the piping plover or its critical habitat, further consultation with this office will be necessary.

The red knot (*Calidris canutus rufa*), proposed for federal listing as a threatened species, is a medium-sized shorebird about 9 to 11 inches (23 to 28 centimeters) in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot breeds in the central Canadian arctic but is found in Louisiana during spring and fall migrations and the winter months (generally September through March).

During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and they roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams (*Donax variabilis*), a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation. If implementation of the proposed action has the potential to directly or indirectly affect the red knot or its habitat, further consultation with this office will be necessary.

Beginning in 2010, the Louisiana Department of Wildlife and Fisheries, in cooperation with the U.S. Fish and Wildlife Service and the U.S. Geological Survey, began efforts to establish a nonmigratory flock of whooping cranes (*Grus americana*) into historic southwestern Louisiana habitat on the state-owned White Lake Wetlands Conservation Area in Vermilion Parish, Louisiana. This reintroduced population was designated as a nonessential experimental population (NEP) under section 10(j) of the Endangered Species Act of 1973 (ESA), as amended. A NEP population is a reintroduced population believed not to be essential for the survival of the species, but important for its full recovery and eventual removal from the endangered and threatened list. These populations are treated as "threatened" species except that the ESA's section 7 consultation regulations (requiring consultation with the U.S. Fish and Wildlife Service to reduce adverse impacts from Federal actions) do not apply (except where the species occurs within National Parks or National Wildlife Refuges) and critical habitat cannot be designated. The only natural wild population of the endangered whooping crane remains vulnerable to extirpation through a natural catastrophe or contaminant spill, due primarily to its limited wintering distribution along the Texas gulf coast.

The Sprague's pipit (*Anthus spragueii*), is a candidate species for federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a

proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Migration and wintering ecology of this species is poorly known, but Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. Its use of an area is dependent upon habitat conditions. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds.

There is currently no requirement under the Endangered Species Act for consultation regarding project impacts on candidate species. In the interest of conserving the Sprague's pipit, we encourage you to avoid project activities that would adversely affect this species or its habitat. Should it be federally listed as threatened or endangered in the future, however, further consultation on project impacts to this species could then be necessary.

West Indian manatees, federally listed as an endangered species, occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatees have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

All contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations would be resumed. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).)

The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/570-5312) in St. Petersburg, Florida, for

information concerning this and other sea turtle species in their aquatic environment.

Wildlife Management Areas and Parks

Sabine NWR is comprised of 124,511 acres of coastal marsh west of the Calcasieu Lake, and its primary management objective is to preserve a large area of coastal wetlands for wintering and migrating waterfowl from both the Mississippi and Central Flyways. This refuge is also a major nursery area for many estuarine-dependent marine species as well as being the home for alligators and other reptiles, mammals, and numerous wading, water and marsh birds. Cameron Prairie NWR is located east of Calcasieu Lake. Two units (i.e., the Gibbstown and East Cove units) compose this refuge and provide fresh marsh and brackish to saline marsh habitats to support alligators, cottonmouth snakes, white-tailed deer, rabbits, roseate spoonbills, and more than 200 other birds, as well as shrimp, crabs, and many species of fish. Lacassine NWR is located in the Mermentau Basin, northwest of Grand Lake, and is very heavily used by wintering waterfowl. Should proposed project activities directly or indirectly effect those NWRs, please contact Mr. Don Voros, the Southwest Louisiana National Wildlife Refuge Complex Leader (337-598-2216), to obtain a Compatible-Use Determination, and to ascertain the need for a Special Use Permit that may be required should work be conducted on that NWR. The Rockefeller Wildlife Refuge, owned and operated by the Louisiana Department of Wildlife and Fisheries is located south of Grand Chenier in the Mermentau Basin. This 76,000-acre refuge consists of numerous tidal marsh management units operated to provide habitat for wintering migratory waterfowl. Project activities on Rockefeller Refuge should be coordinated with the Refuge manager (337-491-2593).

Future Fish and Wildlife Resources

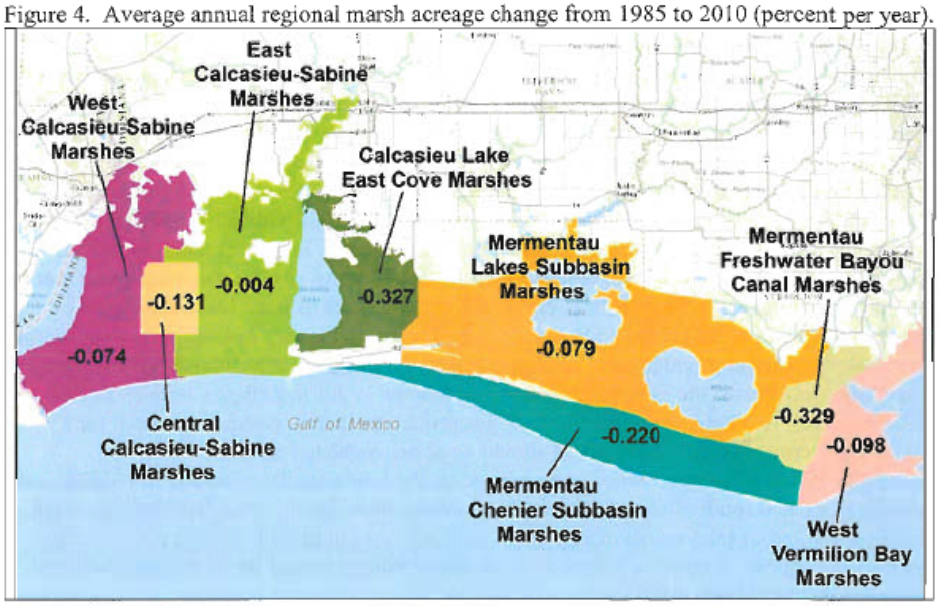
Loss of coastal marshes is the primary problem affecting study area fish and wildlife resources. Satellite land acreage data (1985-2010) from the U.S. Geological Survey (USGS) was plotted and linear regressions were used to calculate average annual loss rates in percent of 1985 acres per year. Regression derived acreages were aggregated to generate regional loss rates (Figure 4).

Throughout the study area, an average of 930 acres has been lost per year from 1985 to 2010 (Table 1). Hurricane Rita (2005) and Hurricane Ike (2008) caused substantial marsh losses and have likely driven marsh loss rates higher than the rates that existed prior to those storms.

Table 1. Average annual marsh acres lost (1985 to 2010).

Calcaiseu-Sabine Basin				Mermentau Basin	
West Cal-Sab Marshes	Central Cal-Sab Marshes	East Cal-Sab Marshes	East Calcasieu Lake Marshes	Merm. Lakes Subbasin Marshes	Merm. Chenier Subbasin Marshes
-119	-39	-5	-197	-231	-338
			-361		-569

Figure 4. Average annual regional marsh acreage change from 1985 to 2010 (percent per year).



Marsh loss within the West Calcasieu-Sabine marshes is the result of recent rapid losses in the Cameron Meadows Oil and Gas Field north of Johnsons Bayou. Observations suggest that the marsh in this area has drowned and no cause is plausible other than mineral extraction related subsidence and associated drowning of marsh vegetation. Without the recent losses in that area, the regional loss rate would actually be positive (no land loss). Central and East Calcasieu-Sabine regions were relatively stable until impacted by Rita and Ike. Recent marsh creation and dredged material disposal efforts have partially offset hurricane related losses in that east region. Marshes east of Calcasieu Lake and throughout the Mermentau Basin were also adversely impacted by these recent hurricanes.

A major cause of marsh loss in the Calcasieu-Sabine Basin has been saltwater intrusion caused by the construction and enlargement of the Calcasieu River and Pass navigation channel, the GIWW, and the Sabine Neches Waterway (LCWCRTF 1998). Those deep-draft channels increased salinity levels throughout the estuary. The increased salinity stressed fresh and intermediate marsh vegetation, contributing to plant death and ultimately conversion of those marshes to shallow open water. Those hydrology changes resulted in the rapid conversion of interior low-salinity marshes to open water and brackish marshes. Once those losses had occurred, loss rates decreased as the most vulnerable areas had become open water. However, saltwater intrusion continues to impact sensitive low-salinity marsh areas during drought-induced high salinity periods.

Prior to Hurricanes Rita and Ike, the Lakes Subbasin marshes and other study area marshes were relatively stable. However, significant study area marsh loss occurred prior to 1985
Other Mermentau Basin problems include shoreline erosion along the Gulf of Mexico, which is greatest in the vicinity of Rockefeller Refuge where 30 to 40 feet per year is lost to the Gulf (van Beek and Meyer-Arendt 1982 and Williams et al. 1992).

Shoreline erosion is also a problem along the shores of large lakes such as Calcasieu Lake, Sabine Lake, Grand Lake, and White Lake. Ship wakes and wind waves are the predominant mechanism of erosion causing the Calcasieu Ship Channel to widen at an average of 7.5 feet per year in this reach (Fischenich 2004).

Using tide gage data from the Sabine Pass tide gage and U.S. Army Corps of Engineers methods, a subsidence rate of 3.9 mm/year has been calculated and is assumed to be the rate affecting the entire study area. The combination of subsidence and sea level rise is called submergence or relative sea level rise. Submergence causes marshes to become inundated with higher water levels, stressing most non-fresh marsh plants and leading to plant death and conversion of marshes to open water. Other major causes of study-area marsh loss include altered hydrology, storm events, and developments including the direct and indirect impacts of dredge and fill activities (LCWCRTF 1998).

Wetland losses result in increasing acreage of open water. Continued wetland losses are expected to cause significant declines in coastal fish and shellfish production and in the study area's carrying capacity for migratory waterfowl, wading birds, other migratory birds, alligators, furbearers, and game mammals such as white-tailed deer and swamp rabbit. Wetland losses will also reduce storm surge protection of developed lands, and will likely contribute to water quality degradation associated with excessive nutrient inputs.

Aside from marsh loss, salt water intrusion has converted fresh marsh habitats to more brackish communities. Marshes not hydrologically managed will continue to provide habitat for more salt tolerant species. Because of continued saltwater intrusion, habitat quantity and quality for freshwater fishes, waterfowl, alligators, and more freshwater-tolerant estuarine species (i.e., Gulf menhaden, white shrimp) will continue to decrease throughout most of this area. Habitat quantity will increase for species such as brown shrimp, spotted seatrout, and black drum, which prefer brackish and saline conditions (LCWCRTF 1999). However, continued degradation of those brackish and saline marshes may reduce production of those fish and shellfish.

DESCRIPTION OF ALTERNATIVES AND RECOMMENDED PLAN

Project goals are to provide hurricane protection and ecosystem restoration that improves ecosystem sustainability. Specific planning objectives were identified to solve the problems by taking advantage of opportunities (Table 2).

Table 2. Protection and restoration planning objectives.

Objective No.	Objective Description
1	Reduce the risk of damages and losses from hurricane and storm surge flooding in southwest Louisiana
2	Manage tidal flows in southwest coastal Louisiana to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh
3	Increase wetland productivity in southwest coastal Louisiana in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
4	Reduce shoreline erosion and stabilize canal banks in southwest coastal Louisiana areas to protect adjacent wetlands.
5	Restore landscapes, including marsh, shoreline, and cheniers in southwest coastal Louisiana, to maintain their function as wildlife habitat and improve their ability to serve as protective barriers

Storm surge protection alternatives were developed to protect the communities of Lake Charles/Sulphur and Abbeville/Erath/Delcambre (Figures 5, 6, and 7). Each of those alignments was evaluated at levee heights to protect against 0.5 percent, 1.0 percent, and 2.0 percent annual chance of occurrence storms. In addition to those traditional levee alternatives, non-structural alternatives consisting of buyouts and elevating flood prone structures have also been evaluated throughout the study area.

The only protection levee alignment with a benefit/cost ratio greater than one is the Lake Charles Eastbank alignment. In the Abbeville/Erath/Delcambre area, all of the alternative levee alignments had a benefit/cost ratio less than one. Consequently, the Lake Charles Eastbank alignment has been selected for inclusion in the TSP along with non-structural measures also determined to be most cost effective (Figure 8).

Ecosystem restoration measures were classified into either hydrology/salinity control measures, marsh creation measures, shoreline protection measures, chenier restoration/reforestation, or oyster reef restoration measures (to improve wetland hydrology). The hydrology/salinity control measures consist of water control structures and/or navigation locks at Sabine Pass and Calcasieu Pass to reduce saltwater intrusion into the estuary, or control structures to reduce marsh flooding and saltwater intrusion from Calcasieu Lake into interior marshes. Marsh creation and shoreline protection measures were strategically located to protect areas where erosion and marsh loss could result in the establishment of new channels connecting the Gulf of Mexico with interior marshes. Candidate measures were screened based on cost effectiveness, and only the most cost effective measures were retained.

Figure 5. Lake Charles/Sulphur area alternative levee alignments.

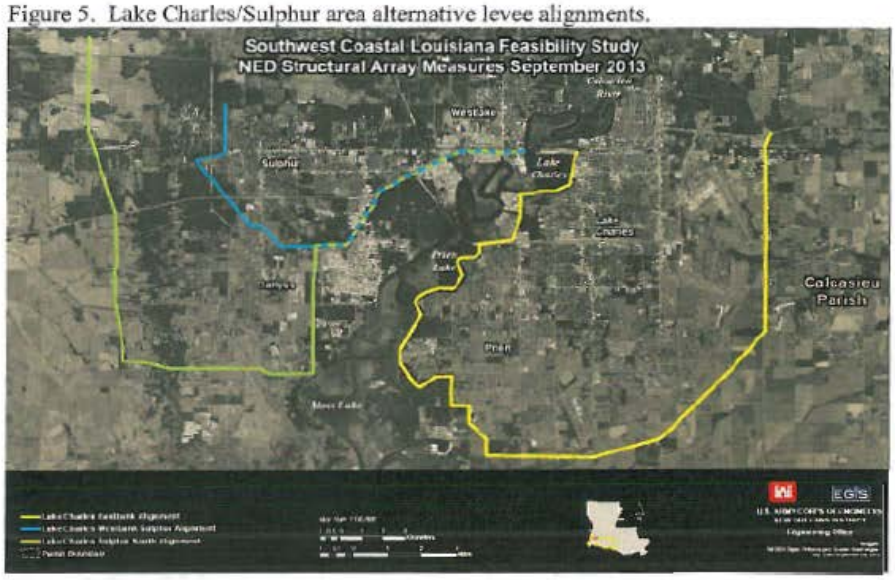


Figure 6. Abbeville/Erath/Delcambre area alternative levee alignments.

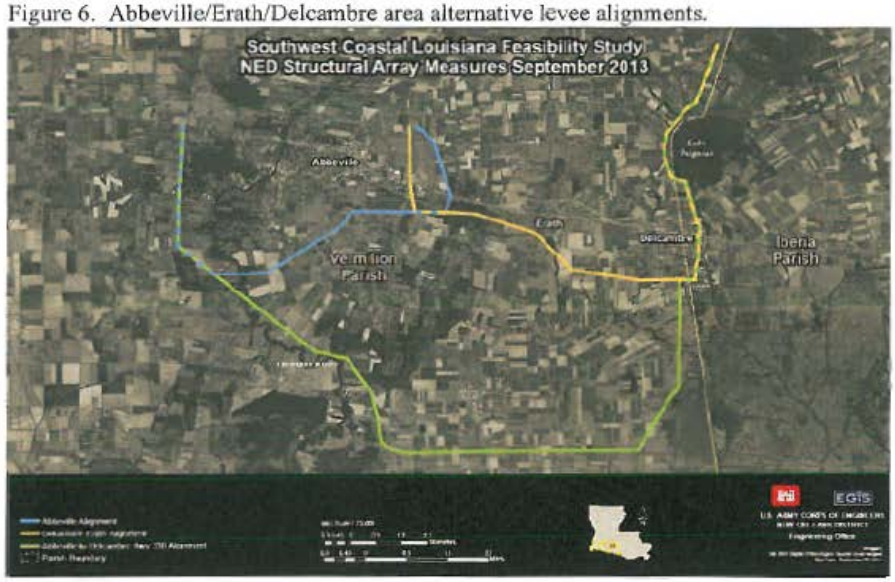


Figure 8. Map of non-structural protection reaches included in the TSP.

The retained measures were then combined to create an array of restoration alternatives (Table 3). Alternative 1, the Large Integrated Restoration across Basins plan, incorporates all hydrology/salinity control measures, except the Gum Cove Ridge control structure, plus the full array of marsh creation and shoreline protection features, plus all chenier restoration features. Alternative 2, the Moderate Integrated Restoration plan, is similar to Alternative 1 except that it has a reduced number of marsh creation and shoreline protection features. Alternative 3, the Moderate Integrated Restoration Plan with Gum Cove, is identical to Alternative 2 except that it includes the Gum Cove Ridge water control structure. Alternative 4, the Entry Salinity Control plan, includes the water control structures that regulate exchange with the Gulf (this includes the Catfish Point structure), plus a lesser number of marsh creation and shoreline protection features compared to Alternatives 2 and 3. Chenier restoration is included in this and all alternatives. Alternative 5 is similar to Alternative 4 except that Alternative 5, the Interior Perimeter Control plan, includes hydrology/salinity control measures that are limited to the interior perimeter control structures (including the Catfish Point structure and the Gum Cove Ridge structure). Chenier restoration is included in Alternative 5. Alternative 6, the Marsh and Shoreline plan, includes the same interior perimeter hydrology/salinity control measures, minus the Gum Cove control structure, and it includes all marsh creation measures, most of the shoreline protection measures, and all chenier restoration measures.

Table 3. Ecosystem restoration alternatives evaluated.

Alternative Number	Alternative Description
1	Large Integrated Restoration Across Basins
2	Moderate Integrated Restoration
3	Moderate Integrated Restoration w/ Gum Cove
4	Entry Salinity Control Focus
5	Interior Perimeter Control Focus
6	Marsh & Shoreline Focus

Restoration Alternative 4 (Entry Salinity Control Alternative), minus the Calcasieu Pass control structure, was initially chosen as the most cost effective of the comprehensive plans and was included in the TSP. However, subsequent consideration resulted in modifying alternative 4 to eliminate the Sabine Pass salinity control structure (measure 48) and to add the shoreline protection measures on the Gulf shore at Rockefeller Refuge (measures 6B1, 6B2, and 6B3. TSP measures in the Calcasieu-Sabine and the Mermentau Basins are illustrated in Figures 9 and 10, respectively, and listed in Table 4.

Table 4. Restoration measures comprising the TSP.

Basin	Measure Type	Measure Number	Measure Description
CS	Oyster Reef	604	Preservation of historic Sabine oyster reefs
CS	Hydrology	74a	Cameron spillway structure at east Calcasieu Lake
CS	Marsh Creation	124c	Marsh creation at Mud Lake
CS	Marsh Creation	124d	Marsh creation at Mud Lake
CS	Marsh Creation	3a1	Beneficial use of dredged material from ship channel
CS	Marsh Creation	3c1	Beneficial use of dredged material from ship channel
CS	Shoreline Prot.	5a	Holly Beach shoreline protection
CS	Chenier Rest.	416	Chenier restoration: Grand Chenier
CS	Chenier Rest.	510a	Chenier restoration: Blue Buck Ridge
CS	Chenier Rest.	510b	Chenier restoration: Hackberry Ridge
CS	Chenier Rest.	510d	Chenier restoration: Front Ridge
Merm	Hydrology	13	Freshwater retention sill on Little Pecan Bayou
Merm	Marsh Creation	127c3	Marsh creation at east Pecan Island
Merm	Marsh Creation	306a1	Marsh creation at Rainey marsh (SW portion)
Merm	Marsh Creation	47a1	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47a2	Marsh creation using dredged material south of Hwy 82
Merm	Marsh Creation	47c1	Marsh creation using dredged material south of Hwy 82
Merm	Shoreline Prot.	16b	Fortify spoil banks of GIWW and Freshwater Bayou
Merm	Shoreline Prot.	6b1	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b2	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Shoreline Prot.	6b3	Gulf shore protection: Calc River to Freshwater Bayou
Merm	Chenier Rest.	416	Chenier restoration: Grand Chenier ridge
Merm	Chenier Rest.	509c	Chenier restoration: Bill Ridge
Merm	Chenier Rest.	509d	Chenier restoration: Cheniere au Tigre
Merm	Chenier Rest.	510d	Chenier restoration: Front Ridge

FISH AND WILDLIFE CONCERNS IN THE PROJECT AREA

Major fish and wildlife resource concerns in the study area include ecosystem-wide hydrologic alterations associated with construction of major navigation channels within the study area and the resulting loss of coastal marsh and the conversion of fresher marshes to more saline habitats. Marsh loss due to shoreline erosion along the Gulf of Mexico is also a problem. The Service is also concerned with water-quality degradation from agricultural and urban run-off, and industrial discharges, into upper Calcasieu Basin waterbodies. Forested areas that once provided habitat for neotropical migrants have suffered extensive losses and continue to be lost to development and sea level rise and subsidence.

The coastal marshes of the Calcasieu-Sabine Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture, as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is

therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. Aside from being a key waterfowl wintering area, the Chenier Plain provides important year round habitat for over 90 % of the continental population of mottled ducks and serves as a key breeding area for whistling ducks. The goal of the NAWMP, Chenier Plain Initiative is to provide wintering and migration habitat for significant numbers of dabbling ducks, diving ducks, and geese (especially lesser snow and greater white-fronted), as well as year-round habitat for mottled ducks. Because wintering waterfowl prefer fresh and intermediate marshes, and because navigation projects have contributed to substantial reductions in those preferred waterfowl habitats, measures to reduce salinity levels would have a positive impact of waterfowl habitat quantity, quality, and usage.

To counter saltwater intrusion effects resulting from the construction and enlargement of the Calcasieu Ship Channel, and to restore former low-salinity habitats, the U.S. Fish and Wildlife Service installed three water control structures on Sabine National Wildlife Refuge (in 1981) to regulate saltwater intrusion entering marshes west of Calcasieu Lake. Similarly, the U.S. Department of Agriculture's Cameron-Creole Watershed East Cove Unit project (completed in 1989) was constructed to regulate water levels and reduce saltwater intrusion impacts in the fresh and intermediate marsh habitats in the marshes east of Calcasieu Lake. Operation of these water control structures to rectify ecosystem alterations may at times interrupt ingress and egress of estuarine-dependent fish and shellfish, resulting in unintended fisheries impacts. Proposed hydrology restoration measures could also result in additional fisheries impacts. Those impacts could be reduced through water control structure operation plans designed to accommodate fisheries needs to the greatest degree possible, while still achieving salinity control goals.

Concerns exist that a future break of the eroding Gulf of Mexico shoreline into deteriorating interior marshes would create a new tidal pass, and would result in harmful salinity increases within interior marshes. Depending upon the location of such shoreline breaches, the resulting impacts could have ecosystem scale impacts. To avoid such impacts, shoreline protection and marsh creation measures have been proposed in strategic locations where such scenarios appear more likely.

Water quality impacts associated with urban and agriculture runoff are ubiquitous concerns that are difficult to address. However, designing all intercepted drainage pump stations to discharge into wetlands may provide some reduction of those impacts. Borrow canals dredged for levee construction could enhance delivery rates of runoff to wetlands and aggravate such impacts. A more serious concern exists where the proposed levee would be constructed in marshes and waterbottoms contaminated with dioxins, polychlorinated biphenyls and heavy metals. Construction activities might resuspend those contaminants allowing tidal action and rainfall runoff to then distribute the contaminants to other portions of the system.

Figure 9. TSP measures in the Calcasieu-Sabine Basin

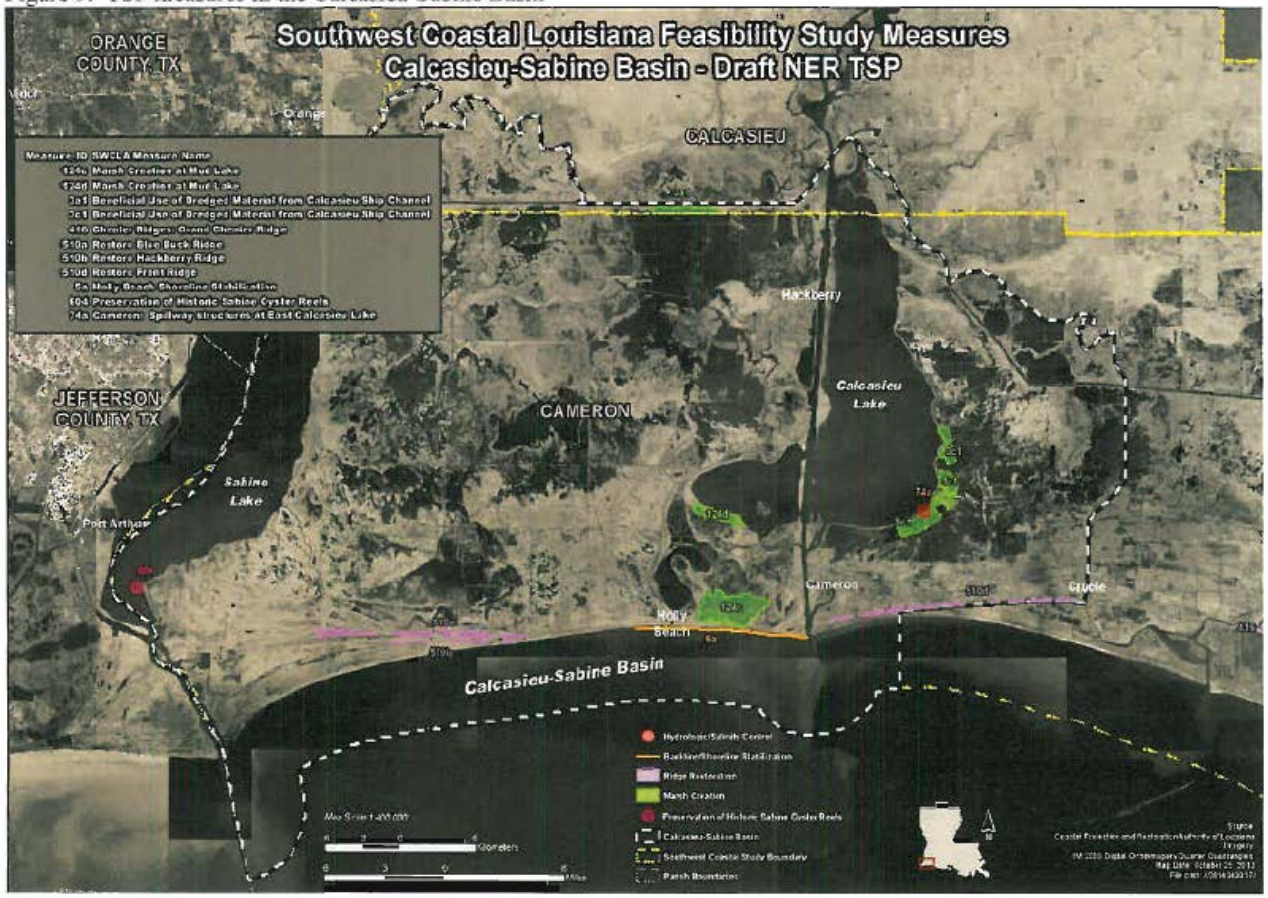


Figure 10. TSP measures in the Mermentau Basin.

25

Study area chenier ridges were historically forested. Residential and agricultural development has resulted in the clearing of most of the formerly forested areas. Mining of sand has also resulted in additional impacts to the chenier forests and to the chenier landforms. In addition to impeding storm surges, forested cheniers provide important stopover habitat for trans-Gulf neotropical migratory songbirds. Proposed measures to restore forested chenier habitats would benefit those migratory species, many of which have experienced population declines in recent decades.

EVALUATION METHODOLOGY

Levee construction impacts were determined by overlaying levee footprint shapefiles on Bing imagery (dated March 2010 to January 2011). After field inspection of impacted areas (September 3, 2013) to confirm habitat types impacted, the acreage of impacted fish and wildlife habitats was digitized and summarized.

The contractor utilized the Wetland Value Assessment (WVA) methodology to determine benefits for environmental restoration measures (benefits in Average Annual Habitat Units [AAHUs]). However, given the preliminary design status of the proposed restoration measures and the compressed study schedule, the Service has instead focused on the contractor's estimated net wetland acreage benefits at the end of the project's 50-year life (future with project acreage minus future without project acreage). Net acres for marsh creation measures were determined using typical spreadsheet methods and standard assumptions (created marshes lost at 50 percent of the background rate). Shoreline protection net acreage was also determined using spreadsheet methods and the assumption that Gulf shoreline protection features reduced background loss rate 50 percent while interior protection features reduced loss rates 100 percent.

Wetland acreage benefits associated with the proposed hydrology/salinity control structures were determined using the Wetland Morphology, Eco-Hydrology, and Vegetation models developed for evaluating the 2012 State Master Plan to provide a scientifically sound and defensible way to estimate the comprehensive benefits of those measures (Meselhe et al. 2013, Couvillion et al. 2013, and Visser et al. 2013). Because those measures were already analyzed using these models as part of the 2012 State Master Plan formulation, those results were used to screen proposed H&S measures. In general, the H&S measures carried forward in the study were those that had larger-scale benefits, i.e., those that helped maintain greater than 500 net acres as determined by the Master Plan models.

POTENTIAL SIGNIFICANT IMPACTS

The resulting preliminary direct construction impacts to marsh and forested areas are provided below for each levee alignment (Table 5). TSP impacts for the Lake Charles Eastbank levee alignment include 23.04 acres of bottomland hardwoods, 6.4 acres of intermediate marsh, 22.16 acres of brackish marsh, and approximately 383.97 acres of non-wetland forest.

Table 5. Preliminary direct levee construction impacts to wetlands and forested habitats.

Habitat Type	Lake Charles Sulphur South Alignment (acres)	Lake Charles Westbank Sulphur Alignment (acres)	Lake Charles Eastbank Alignment (acres)	Abbeville to Delcambre Hwy 330 Alignment (acres)	Abbeville Alignment (acres)	Delcambre Erath Alignment (acres)
Pine Plantation	0.00	0.00	39.71	0.00	0.00	0.00
Dry Pine-Oak	161.88	54.92	99.66	0.00	0.00	0.00
Dry Hardwoods	0.00	0.00	0.00	12.78	19.41	7.13
Hydric Pine-Oak	216.76	0.00	284.31	0.00	0.00	0.00
Bottomland Hardwoods	0.00	0.00	23.04	16.63	13.80	4.20
Brackish Marsh	27.79	19.40	22.16	0.00	0.00	0.00
Intermediate Marsh	0.00	0.00	6.40	0.00	0.00	0.00
Swamp	0.00	0.00	0.00	0.00	0.00	45.64
Wetland TOTAL	27.79	19.40	51.60	16.63	13.80	49.83

Construction impacts to non-forested agriculture, residential, industrial, or pasture areas have not been determined. The impacted acreages do not include impacts associated with excavation for borrow material. Some levee reaches may block existing drainage ditches and bayous. As a result, levee construction may cause interrupted drainage impacts to developed property and/or adjacent wetlands. For example, in southwestern Lake Charles, near Graywood Plantation Drive, approximately 2.6 acres of brackish marsh would be impounded if drainage structures are not included to maintain tidal hydrology (Figure 11). Additional marsh impoundment impacts may occur in that area, but those impacts cannot be accurately determined because the planning of levee features has not advanced sufficiently. Tidal marshes, forested wetlands, and other forest habitats might also be impounded if drainage structures are not included to provide drainage and maintain tidal hydrology during non-storm periods. Impoundment impacts might range from destroying these habitats to lesser impacts that would reduce habitat quality. Measures to alleviate such indirect impacts have not been developed, nor have such indirect construction impacts been fully determined.

Although ecosystem restoration measures were evaluated using several different methodologies, net wetland acreage (future with project acres minus future without project acres at the end of the 50-year project life) was computed within each methodology (Table 6). Those net acreage values have been used as the benefit metric to compute the cost per benefit values (i.e., cost per year 50 net acreage) used to select the TSP.

Figure 11. Marshes that might be impounded near Gray Plantation Drive.

Table 6. Predicted benefits of ecosystem restoration alternatives.

Alternative	Alternative Description	Acres Created	Acres Nourished	Total Acres	Net Acres	AAHU's
1	**Large Integrated Restoration Across Basins**				**31,960**	**17,898**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				6,614	1,939
	Hydro & Salinity Control				6,126	6,695
	Chenier Reforestation			1,413	1,413	538
2	**Moderate Integrated Restoration**				**28,077**	**14,905**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				7,997	5,892
	Chenier Reforestation			1,413	1,413	538
3	**Moderate Integrated Restoration w/ Gum Cove**				**21,849**	**14,223**
	Marsh Creation	16,059	3,306	19,365	13,820	6,916
	Shoreline Protection				4,847	1,559
	Hydro & Salinity Control				1,769	5,210
	Chenier Reforestation			1,413	1,413	538
4	**Entry Salinity Control Focus**				**20,577**	**9,785**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				9,136	4,785
	Chenier Reforestation			1,413	1,413	538
5	**Interior Perimeter Control Focus**				**12,129**	**5,238**
	Marsh Creation	8,579	4,026	12,605	8,714	4,194
	Shoreline Protection				1,314	268
	Hydro & Salinity Control				688	238
	Chenier Reforestation			1,413	1,413	538
6	**Marsh & Shoreline Focus**				**24,449**	**14,937**
	Marsh Creation	20,149	5,522	25,671	17,807	8,726
	Shoreline Protection				4,895	1,559
	Hydro & Salinity Control				334	4,114
	Chenier Reforestation			1,413	1,413	538

The TSP (see Table 4) is comprised of measures which differ somewhat from those within restoration alternative 4. Estimated acreage benefits of the TSP are provided in Table 7.

Table 7. Estimated benefits of the TSP.

Measure Type	Benefits
Marsh Creation	Net acres = 8714 (create 8579 ac and nourish 4026 acres)
Shoreline Prot.	Net acres = 5509 (266,884 linear feet of protection)
Hydrology	Net acres = 6092 (East Calc. Lake Spillway, Little Pecan Bayou sill)
Chenier Rest.	Reforest 1413 acres

FISH AND WILDLIFE CONSERVATION MEASURES

The President's Council on Environmental Quality defined the term mitigation in the National environmental Policy Act regulations to include:

a) avoiding the impacts altogether by not taking a certain action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impacts by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action; and,
e) compensation for the impacts by replacing or providing substitute resources or environments.

The Service's mitigation policy (Federal Register, Volume 46, Number 15, pages 7656-7663, January 23, 1991) provides guidance to help ensure that the level of mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high-value habitats which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called in-kind mitigation. The mitigation planning goals and associated Service recommendations should be based on the four categories, as shown in Table 8.

Table 8. U. S. Fish and Wildlife Service Resource Categories.

FWS Resource Categories
Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.
Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.
Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.
Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Bottomland hardwood forests and coastal marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Therefore, the Service recommends that unavoidable losses of those habitats should be compensated via in-kind replacement. Because of schedule constraints, habitat quality assessments could not be conducted and only acreages of impacted habitats are available at this time (see Table 4).

Dry (non-hydric soil) hardwoods, dry (non-hydric soil) pine-oak forest, and hydric soil pine-oak forest habitats impacted by levee construction are considered to be relatively abundant. These are assumed to be Resource Category 3 habitats and impacts to such habitats may be mitigated out of kind, but mitigation should consist of some type of forested habitat. The 1,413 acres of proposed chenier reforestation would likely provide more than adequate compensation for impacted Resource Category 3 forest habitats provided that the chenier reforestation is successful. However, the restored chenier habitats will not likely provide sufficient wetland characteristics to mitigate impacts to hydric soil bottomland hardwoods. Consequently, the Service recommends that impacted bottomland hardwood forests be mitigated through a mitigation bank or through other means.

Construction of the proposed protection levee is anticipated to directly impact 28.56 acres of emergent marsh. Indirect levee impacts to marsh and bottomland hardwoods are likely to occur, but the acreage is not yet known. The 8,579 acres of proposed marsh creation would likely provide more than enough mitigation to compensate for both the direct and indirect marsh impacts. However, the proposed marsh creation measures must also address the need to mitigate the marsh impacts in kind (by habitat type). If the proposed marsh creation measures sufficiently address the in-kind requirements, provide a sufficient quantity of compensation, and if the mitigation is successful, then the proposed marsh creation measures may mitigate the unavoidable impacts associated with levee construction.

SERVICE POSITION AND RECOMMENDATIONS

Because the study schedule has precluded detailed planning and interagency input regarding the proposed levee alignments and ecosystem restoration measures, it is likely that further planning and/or agency and public review may result in modifications to those alignments and proposed restoration measures. The Service recommends that levee alignment modifications be made to further reduce impacts to wetlands and forested habitats, and to avoid or reduce indirect impacts to such habitats through interrupted drainage. To avoid interrupted drainage impacts, additional measures such as runoff collection canals and drainage structures through the levee will be needed to maintain drainage of the protected area. The addition of those drainage measures will likely increase costs and project-related wetland impacts. The Service recommends that the Corps solicit input from the Service and other interested natural resources agencies regarding levee alignment modifications to reduce wetland impacts and to develop features to provide drainage of protected areas. Because borrow locations have not yet been identified, borrow

impacts cannot be determined. Additional environmental review and clearance for the borrow sites should be sought once those sites have been determined.

Discharge of polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins/furans, heavy metals, and other hazardous compounds into Bayou D'Inde, Bayou Verdine, and the upper Calcasieu River has impacted the upper Calcasieu River estuary adjacent to the proposed TSP protection levee feature. Dredging and site preparation associated with levee construction in those areas may resuspend contaminants and increase their bioavailability to fish and shellfish which provide an important food source for other fish, alligators, wading birds, and other migratory birds and wildlife.

The Service recommends that the project sponsors conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds NOAA screening levels, then alternative locations should be considered, or, special procedures (e.g., use sediment curtains, etc.) should be implemented to reduce or prevent contaminant re-suspension and dispersal into important downstream fish and wildlife habitats.

For the proposed marsh creation measures, details regarding containment dike location and design, fill elevation, spill box locations, dike degradation protocols, vegetative planting protocols, and other details have not yet been made available to the Service or other interested resource agencies. The Service requests that the Corps work with the Service and interested natural resource agencies to finalize those planning details.

Because submerged aquatic vegetation provides food for migratory waterfowl, and provides high quality nursery habitat for estuarine dependent fisheries (Castellanos and Rozas 2001, and Kanouse et al. 2006), the open water areas targeted for marsh creation measures should avoid areas of dense submerged aquatic vegetation to the greatest degree possible.

Details regarding other ecosystem restoration features such as shoreline protection measures have not yet been provided to the Service. The Service requests that the Corps work with the Service and interested natural resource agencies to finalize those planning details. To understand and concur with the estimated benefits for the installation and operation of the proposed salinity control structures, the assumptions used and an explanation of the modeling methods should be provided to the Service and other interested natural resource agencies.

Ecosystem restoration measures could potentially mitigate all project-related direct and indirect construction impacts. For the restoration measures selected to provide mitigation, the Service recommends that the Corps address the 12 mitigation planning requirements (Appendix A) for each selected mitigation feature.

To determine if mitigation measures have been successful, the Service recommends that the Corps utilize the final mitigation performance protocols developed for the Hurricane Storm Damage Risk Reduction Study. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those

features to document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports.

Because many design details regarding the proposed surge protection levees are yet to be developed, additional planning work must be conducted before impacts can be fully determined. Similarly, the proposed ecosystem restoration measures need additional planning work and interagency coordination to finalize estimated benefits and impacts with any degree of certainty. To complete needed planning of project features, to reduce and avoid project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Service provides the following recommendations:

1. The Corps should conduct further planning of the proposed protection levee to reduce and avoid impacts to wetlands and forest habitats. Additional levee planning work should also include the development of measures to avoid interrupted drainage impacts in a manner that reduces or avoids impacts to wetlands and forested habitats. The additional planning work should be coordinated with the Service and other interested natural resource agencies. Any pump stations needed for drainage of the protected area should be designed to discharge into wetlands to reduce adverse effects of discharging runoff directly into open water bodies

2. The Corps should also determine where levee borrow material will be obtained.

3. To the greatest degree practical, borrow pits for construction of proposed levee and marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives. Borrow pit construction should also avoid the following:
    a. avoid inducing wave refraction/diffraction erosion of existing shorelines
    b. avoid inducing slope failure of existing shorelines
    c. avoid submerged aquatic vegetation
    d. avoid increased saltwater intrusion
    e. avoid excessive disturbance to area water bottoms
    f. avoid inducing hypoxia

4. Once levee planning has been completed, the Corps should revise estimates of direct and indirect impacts to wetlands and forested habitats, including impacts associated with acquisition of borrow material. That work should be conducted in cooperation with the Service and other interested natural resource agencies.

5. The Corps should conduct a Hazardous, Toxic and Radioactive Waste (HTRW) assessment of tidally influenced levee construction locations and subaqueous marsh creation borrow sites. If those HTRW assessments indicate that contamination exceeds NOAA screening levels, then alternative locations should be considered, or, explanation

of the containment methods that would allow levee construction should be provided to the Service and other interested natural resource agencies.

6. For ecosystem restoration measures not being used to mitigate construction impacts, the Service recommends that the Corps conduct monitoring of those features to document the degree of success achieved. The Service and other interested natural resource agencies should be involved in developing those monitoring criteria and in the review of subsequent monitoring information and reports. For mitigation features, the Service also recommends that all interested natural resource agencies be involved in the planning of project features, monitoring plans, development of success criteria, and adaptive management plans. In addition, all mitigation plans should address the 12 mitigation requirements in Appendix A.

7. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

8. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex; furthermore, all activities on NWRs must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

9. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

10. The Corps should continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, and threatened or endangered species that may be listed in the future.

Given that the design and evaluation of most project features has been at a programmatic level, the Service cannot fulfill its Fish and Wildlife Coordination Act (FWCA)(48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) responsibilities at this time. Therefore, this draft report is presented in partial fulfillment of that act and does not constitute the final report of the Secretary of Interior as required by Section 2(b) of the FWCA. To complete those assessments, we will require additional funding during the project's pre-construction engineering and design phase.

Estimates of those funding needs should be coordinated in advance with the Service, and should be based on the extent of remaining work and the nature and complexity of issues associated with the remaining planning/design issues.

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APPENDIX A

TWELVE REQUIRMENTS FOR MITIGATION PLANNING
(from the U.S. Army Corps of Engineers & EPA 2008 Final Mitigation Rule in the FEDERAL REGISTER Vol. 73, No. 70, April 10, 2008)

Twelve Requirements for a Compensatory Mitigation Plan

1. Objectives. A description of the resource type(s) and amount(s) that will be provided, the method of compensation (restoration, establishment, preservation etc.), and how the anticipated functions of the mitigation project will address watershed needs.

2. Site selection. A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the mitigation project site.

3. Site protection instrument. A description of the legal arrangements and instrument including site ownership, that will be used to ensure the long-term protection of the mitigation project site.

4. Baseline information. A description of the ecological characteristics of the proposed mitigation project site, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other characteristics appropriate to the type of resource proposed as compensation. The baseline information should include a delineation of waters of the United States on the proposed mitigation project site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site.

5. Determination of credits. A description of the number of credits to be provided including a brief explanation of the rationale for this determination.
    - For permittee-responsible mitigation, this should include an explanation of how the mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.
    - For permittees intending to secure credits from an approved mitigation bank or in-lieu fee program, it should include the

number and resource type of credits to be secured and how these were determined.

6. Mitigation work plan. Detailed written specifications and work descriptions for the mitigation project, including: the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water; methods for establishing the desired plant community; plans to control invasive plant species; proposed grading plan; soil management; and erosion control measures. For stream mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

7. Maintenance plan. A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

8. Performance standards. Ecologically-based standards that will be used to determine whether the mitigation project is achieving its objectives.

9. Monitoring requirements. A description of parameters monitored to determine whether the mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting monitoring results to the DE must be included.

10. Long-term management plan. A description of how the mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

11. Adaptive management plan. A management strategy to address unforeseen changes in site conditions or other components of the mitigation project, including the party or parties responsible for implementing adaptive management measures.

12. Financial assurances. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

Other information. The DE may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the mitigation project.

SOUTHWEST COASTAL LOUISIANA
REVISED INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex H

U.S. Fish and Wildlife Service Scoping / Planning Aid Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506
October 9, 2009

Colonel Alvin B. Lee
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

Please reference your September 29, 2009, letter requesting our participation as a cooperating agency for the Southwest Coastal Louisiana Protection and Restoration Feasibility Study that would be conducted by the U.S. Army Corps of Engineers (Corps). The study, which would involve the preparation of an environmental impact statement (EIS), would investigate the feasibility of providing Federal hurricane protection and storm damage reduction, as well as restoring and protecting fish and wildlife habitat, in portions of Calcasieu, Cameron, and Vermilion Parishes. The study would include the development of alternative plans (which may incorporate both structural and nonstructural components), identification of significant environmental resources, assessment of beneficial and adverse impacts, and formulation of compensatory mitigation measures, if necessary. The U.S. Fish and Wildlife Service (Service) has reviewed the information provided, and offers the following comments in accordance with the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Corps and the Service have formally committed to work together to conserve, protect, and restore fish and wildlife resources while ensuring environmental sustainability of our Nation's water resources under the January 22, 2003, Partnership Agreement for Water Resources and Fish and Wildlife. Accordingly, the Service would be pleased to serve as a cooperating agency in developing the EIS for the proposed project in accordance with applicable NEPA/Council on Environmental Quality guidance. Our participation will be specifically limited to: 1) participating in meetings and field trips to obtain baseline information on project-area fish and wildlife resources; 2) evaluating the proposed project's impacts to wetlands and associated fish and wildlife resources, and assisting in the development of measures to avoid, minimize, and/or compensate for those impacts; and 3) providing technical assistance in the development of a Biological Assessment describing the impacts of the proposed activity to federally listed threatened or endangered species and/or their critical habitat.

We appreciate the opportunity to assist the Corps during the planning of the proposed feasibility study. If you require further assistance in this matter, please contact Mr. David Soileau, Jr. (337/291-3109) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

March 27, 2009

Colonel Alvin B. Lee
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

The U.S. Fish and Wildlife Service (Service) has reviewed the Department of the Army, Corps of Engineers (Corps), Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement (DEIS) for the Southwest Coastal Louisiana Feasibility Study for Calcasieu, Cameron, and Vermilion Parishes, Louisiana. The NOI was published in the Federal Register (Volume 74, No. 38, pg. 8920) on February 27, 2009 (Department of Interior No. ER09/0228). The study was authorized by a resolution adopted by the United States House of Representatives (House) Committee on Transportation and Infrastructure on December 7, 2005. The Fish and Wildlife Service (Service) submits the following comments in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Migratory Bird Treaty Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Corps is conducting a study to determine the feasibility of providing Federal hurricane protection and storm damage reduction for portions of Calcasieu, Cameron, and Vermilion Parishes. A specific focus of that study, which is explicitly mentioned in the above-referenced House Committee resolution, will include an evaluation of the feasibility of constructing an armored 12-foot-high levee along the Gulf Intracoastal Waterway. However, numerous other levee alignments and project alternatives are under consideration, including those that would involve a variety of structural, non-structural, and coastal restoration components.

DESCRIPTION OF FISH AND WILDLIFE RESOURCE CONDITIONS

Most of the fish and wildlife habitat within the proposed study area exists as fresh, intermediate, brackish, and saline marshes. There are numerous rivers, bayous, canals, ponds, lakes, and other open water areas within those marshes that would also be affected by the proposed project. The study-area marshes and cheniers provide habitat for a variety of migratory game and non-game birds such as mallard, gadwall, American wigeon, common pintail, black rail, yellow rail, and little blue heron. Those non-game species have exhibited substantial population declines

over the last 30 years, primarily as the result of habitat loss and fragmentation. Numerous reptiles and amphibians inhabit the marshes, bayous, and ponds of the study area including lesser siren, three-toed amphiuma, Gulf Coast toad, eastern narrow-mouthed toad, spring peeper, green treefrog, cricket frog, bullfrog, American alligator, common snapping turtle, alligator snapping turtle, diamondback terrapin, red-eared slider, painted turtle, Mississippi mud turtle, stinkpot, various water snakes, western ribbon snake, speckled kingsnake, and the western cottonmouth. The study area wetlands also help to reduce the impact of storm surges on more inland habitats and infrastructure, and aid in water quality maintenance by reducing excessive dissolved nutrient levels and removing suspended sediments. They provide plant detritus to surrounding estuarine waters, thereby substantially contributing to the detritus-based food web that supports the productivity of commercially and recreationally important fisheries. Brackish and saline marshes support estuarine-dependent (i.e., inter-jurisdictional) fishes and shellfishes (e.g., red drum, Atlantic croaker, Gulf menhaden, blue crab, brown shrimp, and white shrimp). Fresh and intermediate marshes of the study area provide habitat for mammals such as raccoon, mink, and swamp rabbit, and support many commercially and recreationally important fishes such as largemouth bass, black crappie, sunfishes, catfishes, freshwater drum, buffalos, and gars. The numerous cheniers located throughout the proposed project area provide important stopover habitat for as many as 250 species of neotropical migratory songbirds, including a variety of warblers, tanagers, orioles, thrushes, vireos, and grosbeaks.

Most development within the southern portions of the study area is located immediately adjacent to major state highways in the area including Louisiana Highways 82, 27, and 14. The most significant residential, commercial, and industrial developments are within, and immediately surrounding, the cities of Lake Charles and Abbeville. Various types of agriculture, such as sugarcane, rice, crawfish, and livestock production, are also present within the study area.

Threatened and Endangered Species

Federally listed as a threatened species, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and

the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Should the proposed project directly or indirectly affect the piping plover or its critical habitat, further consultation with this office will be necessary.

Federally listed as an endangered species, brown pelicans (*Pelecanus occidentalis*) are currently known to nest on Rabbit Island in Calcasieu Lake. Pelicans change nesting sites as habitat changes occur. In spring and summer, nests are built in mangrove trees or other shrubby vegetation, although ground nesting may also occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance. Should the proposed project directly or indirectly affect brown pelicans, further consultation with this office will be necessary.

Endangered and threatened sea turtles forage in the nearshore waters, bays and sounds of Louisiana. The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/824-5312) at the NMFS Regional Office in St. Petersburg, Florida, for information concerning those species in the aquatic environment. When sea turtles leave the aquatic environment and come onshore to nest, however, the Service is responsible for consultation. Accordingly, we recommend that you contact this office if your activities would occur on beach areas during the sea turtle nesting season (depending on the species in question).

Other Federal Trust Species

Forested portions of the study area may provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water. Eagles also winter, and infrequently nest, in mature pine trees near large lakes. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Potential nest trees within a nesting territory may, therefore, provide important alternative bald eagle nest sites. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest. Nest sites typically include at least one perch with a clear view of the water or area where the eagles usually forage. Shoreline trees or snags located near large waterbodies provide the visibility and accessibility needed to locate aquatic prey. Bald

eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the MBTA and the BGEPA. The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at: http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary. A copy of that determination should be provided to this office. The Division of Migratory Birds for the Southeast Region of the Service (phone: 404/679-7051, e-mail: SEmigratorybirds@fws.gov) has the lead role in conducting such consultations. Should you need further assistance interpreting the guidelines or performing an on-line project evaluation, please contact this office.

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries (LDWF). That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect proposed work sites for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The LDWF Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies.

2. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15; exact dates may vary within this window depending on species present).

3. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1; exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Publicly and Privately Managed Areas

Publicly owned and/or managed lands within the current study area include three National Wildlife Refuges (Sabine, Cameron Prairie, and Lacassine) managed by the Service, the Rockefeller Wildlife Refuge, State Wildlife Management Area, and Rockefeller Refuge Mitigation Bank managed by LDWF, and the Sam Houston Jones State Park managed by the Office of State Parks.

Lands within the study area that managed by non-governmental organizations include the Little Pecan Island Preserve and the Persimmon Gully Mitigation Bank managed by The Nature Conservancy, and the Paul J. Rainey National Audubon Society Preserve managed by the National Audubon Society.

Privately owned and/or managed lands within the current study area include the Gum Cove, Fresh Marsh, Choupique, and Houston River Mitigation Banks (managed by Stream Properties, Inc.), the Bryan Farms Mitigation Bank (managed by Krauss and Managan Timber Company), the Simon and Delaney Mitigation Bank (managed by Mr. Chris Simon), and No Hope Farms Mitigation Bank (managed by Mr. Carl Nabours). There are also two privately owned Wetlands Reserve Program tracts (administered by the Natural Resources Conservation Service) within the study area (Contract #66-7217-9-3386 and Contract #66-7217-1-3616 in Vermilion Parish) that are encumbered by perpetual conservation easements.

Should proposed project alternatives entail work within or adjacent to, or would potentially alter the hydrology of, any of these managed properties, then the respective owner and manager should be contacted. Also, work proposed to occur on National Wildlife Refuge (NWR) lands would require a compatibility determination as mandated by the National Wildlife Refuge System Administration Act of 1966, as amended. (The amended act is now known as the National Wildlife Refuge System Improvement Act of 1997 [16 U.S.C. 668dd]). The Act states that refuge officials (through delegation of authority from the Secretary of the Interior) shall not initiate or permit a new use of a refuge unless the Secretary has determined that it is a compatible use. A compatible use is defined as any use of a refuge that will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of that refuge.

Federal agencies proposing a project that includes features on a NWR are encouraged to contact the refuge staff early in the planning process. Point of contact for the Service's Southwest Louisiana National Wildlife Refuge Complex is Mr. Don Voros, Project Leader (337) 598-2216. Additional activities (e.g., surveys, soil borings, etc.) that may need to occur on the NWR during the planning process may require a Special Use Permit from the Service; furthermore, all activities on that NWR must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work/investigations on a NWR.

Estuarine wetlands and associated shallow waters within the project area have been identified as Essential Fish Habitat (EFH). EFH requirements vary depending upon species and life stage. Categories of EFH in the project area include estuarine emergent wetlands, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA); (P.L. 104-297). Recommendations to minimize and/or avoid impacts to EFH should be developed in coordination with the NMFS.

A portion of the study area lies within units of the Coastal Barrier Resources System. The Coastal Barrier Resources Act (CBRA) restricts Federal expenditures that effectively encourage development of coastal barriers. Coordination with this office should be undertaken to ensure that any proposed project feature is in compliance with the CBRA.

POTENTIAL SIGNIFICANT IMPACTS

Depending on the selected project features, construction of the proposed hurricane protection project has the potential to result in the direct loss of valuable coastal habitats including marsh, swamp, and bottomland hardwood wetlands (including cheniers); those habitats may also sustain losses from secondary impacts related to hydrologic changes in the study area. Developmental pressure on study area wetlands would likely increase should such areas be enclosed by storm-surge protection levees. Reduced water exchange between wetlands enclosed within and those excluded from leveed systems could reduce water quality within the study area by eliminating or reducing the filtering capacity of those wetlands. Wetland habitat losses would reduce populations of resident fish and wildlife, reduce important wintering habitat for waterfowl and other migratory birds, and reduce nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production.

PROBLEMS, OPPORTUNITIES, AND PLANNING OBJECTIVES

The most significant fish and wildlife related problem in the study area and throughout coastal Louisiana is the rapid loss of valuable wetland habitat. Since the 1930s, Louisiana has lost over 1,900 square miles of coastal wetlands; and an additional 24 square miles are being lost every

year (Louisiana Department of Natural Resources' *Coastal Restoration Annual Project Reviews: December 2005*). The two major hurricanes of 2005 (Katrina and Rita) have significantly contributed to those coastal wetland losses, and their effects have exceeded all such changes in coastal Louisiana from the last 13 years of hurricanes combined, including Hurricanes Andrew (1992) and Lili (2002) (U.S. Geological Survey's *USGS Reports Latest Land-Water Changes for Southeastern Louisiana, February 2006*). As a result of the high rate of land loss and the national significance of coastal Louisiana wetlands, several programs (e.g., Americas Wetlands, Coast 2050, the Coastal Wetlands Planning, Protection, and Restoration Act, the Louisiana Coastal Area Ecosystem Restoration Study, the Coastal Impact Assistance Program [CIAP], and the Louisiana Comprehensive Hurricane Protection and Restoration Study) are being planned or implemented to restore and protect Louisiana's coastal wetland ecosystems. Many of the goals of those restoration programs and those of the current coastal hurricane protection study are interrelated and necessitate an integrated solution. Projects should be designed in collaboration with one another to ensure that a system-wide solution for coastal flood protection and restoration for the study area is achieved.

Water quality deterioration may be minimized by preserving remaining wetlands via limiting urban expansion and associated pollution discharges into wetlands. To that end, in order to discourage further wetland loss, any proposed hurricane protection levees should be located landward of the wetland/non-wetland interface. Should some wetlands be unavoidably enclosed within the levee, the integrity of present hydrologic regimes should be maintained via installation of water control structures in the levee to ensure adequate water circulation. Preservation of enclosed wetlands could be ensured via the purchase of non-development easements or local flood zoning ordinances. Furthermore, any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate those nutrients being discharged.

The need for borrow necessary to complete proposed hurricane protection levees may exceed local availability. Often, the searches for levee-building material have been conducted on a project-by-project basis, and have led to the selection of the least-expensive and easiest sources for borrow material, which are usually located within wetlands adjacent to the proposed levee. Use of such on-site sources that adversely impact wetlands is frequently inconsistent with coastal restoration efforts, and is counterproductive to attaining the goal of increasing non-structural hurricane protection within a sustainable ecosystem.

In order to address the above problems and opportunities, the Service recommends that the following planning objectives and constraints be included in any further planning of hurricane protection features for the study area:

1. Avoid and/or minimize impacts to wetlands and fish and wildlife habitat in the study area.

2. The Service's priority selection process for borrow material outlined in our August 7, 2006, letter to the Corps regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction Project should be utilized.

3. Coordinate with the LCA Plan near-term restoration planning team, CWPPRA member-agencies, CIAP representatives, and any other pertinent coastal restoration entities to ensure consistency with the objectives of the projects that may have already been constructed, that are proposed for construction, or that have been identified in planning efforts to occur within the subject study area.

4. Avoid impacts to threatened and endangered species and their habitat.

FISH AND WILDLIFE CONSERVATION MEASURES

Implementation of the proposed hurricane protection plan could potentially have significant direct impacts on fish and wildlife resources. Of equal concern is the potential for loss, via future development, of fish and wildlife habitat enclosed by levees constructed as a result of the plan. The Service believes that project plans can be designed to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

If the enclosure of wetlands within the proposed levee is necessary to provide for storm surge protection, mechanisms for protecting enclosed wetlands and for compensating habitat value losses associated with levee construction should be developed. Preservation of enclosed wetlands may be accomplished by installing water control structures in the levee that could be operated to ensure adequate water exchange. Further, protection of enclosed wetlands from future development could be ensured via purchase of non-developmental easements. Compensation for wetland habitat value losses associated with levee construction would likely involve acquisition and/or restoration of in-kind wetland habitats. Detailed mitigation needs will be determined in the feasibility stage.

1. Mitigate impacts to wetlands by:

    a. Incorporating hurricane protection features (e.g., floodwalls, etc.) that would minimize impacts to fish and wildlife habitat;

    b. Requiring that hurricane protection levees are located landward of the wetland/non-wetland interface, and limiting hurricane protection to existing urban developments;

    c. Requiring that borrow material for levee construction be taken from non-forested, non-wetland areas (the Service's priority selection process for borrow material should be utilized);

d. Installing an adequate number of water-control structures in hurricane protection levees that enclose wetlands to maintain normal water exchange and preclude wetland drainage (such structures should be closed only in advance of tropical storms);

e. Acquiring non-development easements on enclosed wetlands to ensure their continued use as floodwater storage areas and to preclude any secondary development;

f. Incorporating water quality improvements by routing urban runoff through enclosed wetlands and discharging any pumped water into floodside wetlands;

g. Ensuring adequate internal drainage exists within the leveed area to prevent levees from compounding existing flooding problems, thus leading to future flood control projects with a resulting loss of wetlands and fish and wildlife resources; and,

h. Implementing measures to compensate for unavoidable losses of wetland habitat values.

2. Avoid impacts to endangered or threatened species and their habitats.

3. Avoid impacts to other Federal trust fish and wildlife resources such as bald eagles and colonial nesting waterbirds.

4. Avoid impacts to public lands, if feasible. If not feasible, coordination with agencies managing the public lands that would be impacted by the proposed project should occur throughout the planning process.

5. Ensure compliance with CBRA where applicable.

FISH AND WILDLIFE COORDINATION ACTIVITIES FOR THE FEASIBILITY STAGE

The following data will be needed to enable the Service to conduct a detailed analysis of project impacts on fish and wildlife resources and to formulate measures to mitigate any losses to those resources.

1. Identification of all alternatives to be considered, including detailed project plans (e.g., a written description and map) for those alternatives.

2. An estimate of current, future-with, and future-without-project development and land loss rates within the project area(s), presented in 10-year intervals, to be impacted by alternatives being considered.

3. Identification of habitats, by type and acreage, to be impacted by various alternatives being considered. That data should also be presented in 10-year intervals.

We look forward to assisting the Corps in the documentation of existing conditions, development of alternatives, and assessment of effects of project alternatives on Federal trust resources during the subsequent feasibility study. Should you have any questions regarding our comments, please contact David Soileau, Jr. (337/291-3109) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

cc: DOI, OEPC, Washington, D.C. (Attn.: Loretta Sutton)
DOI, OEPC, Albuquerque, NM (Attn.: Steven Spencer)
FWS, BAP & HC (ERT), Arlington, VA (Attn.: Stefanie Nash)
FWS, Atlanta, GA (Attn.: Jeff Weller)
COE, CEMVN-PM-RS, Attention: Sandra Stiles, New Orleans, LA
EPA, Dallas, TX
NMFS, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Kyle Balkum)
LDWF, Natural Heritage Program, Baton Rouge, LA

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APPENDIX A

Annex I

Technical, Institutional and Public Significance of Relevant Resources

Resource	Institutionally Significant	Technically Significant	Publicly Significant
Soils, Water bottoms, Prime and Unique Farmlands	Council on Environmental Quality (CEQ) memorandum dated August 11, 1980, entitled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA)"; Executive Order 11990 - Protection of Wetlands; Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq.*).	Technically significant in determining soils engineering and environmental suitability, based on their physical and chemical properties, for proposed activities. Water bottoms are technically significant because the estuarine bottom sediment characteristics (water bottoms) benthic organismal distribution and is an integral component of the benthic boundary layer.	Significant to the public for determining suitability of construction capabilities, agriculture suitability, and suitability for septic tank type disposal of sanitary waste.
Hydrology	NEPA of 1969; Clean Water Act of 1972; Storm damage Control Act of 1944; Coastal Barrier Resources Act of 1982; Rivers and Harbors Act of 1899; River and Harbor and Storm damage Control Act of 1970; Watershed Protection and Storm damage Prevention Act of 1954; Submerged Lands Act of 1953; Coastal Zone Management Act of 1972; Safe Drinking Water Act of 1974; Estuary Protection Act of 1968; Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response, Compensation and Liability Act of 1980; Executive Order 11988 Floodplain Management.	Civil Works water resources development projects typically impact (positively or negatively) the interrelationships and interactions between water and its environment.	Publicly significant because the public demands clean water, hazard-free navigation, and protection of estuaries and floodplain management.
Water Quality	Clean Water Act of 1972; Pollution Prevention Act of 1990, the Safe Drinking Water Act of 1974; Water Resources Planning Act of 1965.	Technically significant to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.	Publicly significant because of the desire for clean water and water-related activities such as boating, swimming, fishing, and as a source of potable water.
Coastal Shorelines	Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Endangered Species Act of 1973; Estuary Protection Act of 1968l Fish and Wildlife Coordination Act of 1958; Migratory Bird Conservation Act of 1929; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; Fish and Wildlife Conservation Act of 1980; Magnuson-Stevens Fishery Conservation and Management Act of 1976.	Technically significant because they are a critical element of the Gulf coastal barrier habitats.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Vegetation Resources	Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Emergency Wetlands Resources Act of 1986; Estuary Protection Act of 1968; Fish and Wildlife Conservation Act of 1980; Fish and Wildlife Coordination Act of 1958; NEPA of 1969; North American Wetlands Conservation Act of 1989; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; Executive Order 13186 - Migratory Bird Habitat Protection.	Technically significant because they are a critical element of the barrier shoreline habitats. Vegetation resources serve as the basis of productivity, contribute to ecosystem diversity, provide various habitat types for fish and wildlife, and are an indicator of the health of coastal habitats.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.
Wildlife Resources	NEPA of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968; Fish and Wildlife Coordination Act of 1958; Migratory Bird Conservation Act of 1929; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; Fish and Wildlife Conservation Act of 1980; North American Wetlands Conservation Act of 1989; Executive Order 13186 - Migratory Bird Habitat Protection; Marine Mammal Protection Act of 1972.	Technically significant because they are a critical element of the barrier shoreline ecosystem, they are an indicator of the health of various coastal habitats, and many wildlife species are important recreation and commercial resources.	Publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Aquatic Resources	National Environmental Policy Act of 1969; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because plankton provide a major, direct food source for animals in the water column and in the sediments; are responsible for at least 40 percent of the photosynthesis occurring on the earth; important for their role in nutrient cycling; plankton productivity is a major source of primary food-energy for most estuarine systems throughout the world; and phytoplankton production is the major source of autochthonous organic matter in most estuarine ecosystems (Day et al. 1989).	Publicly significant because plankton constitute the lowest trophic food level for many larger organisms important to commercial and recreational fishing. There is also public health concern with noxious plankton blooms (red and brown tides) that produce toxins, and large-scale blooms can lead to hypoxic conditions, which can result in fish kills.
Fisheries	Fish and Wildlife Coordination Act of 1958; Endangered Species Act of 1973; Magnuson-Stevens Fishery Conservation and Management Act of 1976; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968.	Technically significant because they are a critical element of many valuable freshwater and marine habitats, they are an indicator of the health of various freshwater and marine habitats, and many fish species are important commercial resources.	Publicly significant because of the high priority that the public places on their esthetic, recreational, and commercial value. Fisheries resources in the project area include marine and estuarine finfish and shellfish.
Essential Fish Habitat	Magnuson-Stevens Fishery Conservation and Management Act of 1976.	Technically significant because it includes those waters and substrate necessary to Federally-managed fish species for spawning, breeding, feeding or growth to maturity.	Publicly significant because of the high value that the public places on seafood and the recreational and commercial opportunities it provides.
Threatened and Endangered Species	Endangered Species Act of 1973; Marine Mammal Protection Act of 1972; Bald Eagle Protection Act of 1940.	Technically significant because the status of such species provides an indication of the overall health of an ecosystem.	Publicly significant because of the desire of the public to protect them and their habitats.
Cultural and Historic Resources	National Historic Preservation Act of 1966; Abandoned Shipwreck Act of 1987; Archeological Resources Protection Act of 1979; National Environmental Policy Act of 1969.	Technically important because of their association or linkage to past events, to historically important persons, and to design and/or construction values; and for their ability to yield important information about prehistory and history.	Publicly important because preservation groups and private individuals support their protection, restoration, enhancement, or recovery.
Recreational Resources	Federal Water Project Recreation Act of 1965; Land and Water Conservation Fund Act of 1965.	Technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies.	Publicly significant because of the high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Louisiana, and the large per-capita number of recreational boat registrations in Louisiana.
Air Quality	Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended.	Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS).	Air quality is publicly significant because of the desire for clean air and public health concerns expressed by many citizens.
Socioeconomic and Human Resources	National Environmental Policy Act of 1969; Estuary Protection Act of 1968; Clean Water Act of 1972; Rivers and Harbors Act of 1899; Watershed Protection and Storm damage Protection Act of 1954. Executive Order 12898 of 1994 – Environmental Justice.	Technically significant because the social and economic welfare of the Nation may be positively or adversely impacted by the proposed action; the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by proposed actions.	Publicly significant because of the public's concern for health, welfare, and economic and social well-being from water resources projects; also public concerns about the fair and equitable treatment of all people

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Annex J

Environmental Compliance Laws

Table J-1: Relevant Environmental Federal Statutory Authorities and Executive Orders. (Note: this list is not complete or exhaustive.)	
Abandoned Shipwreck Act of 1987	Marine Mammal Protection Act of 1972
American Indian Religious Freedom Act of 1978	Marine Protected Areas (EO 13158) of 2000
Anadromous Fish conservation Act of 1965	Marine Protection, Research, and Sanctuaries Act of 1972
Antiquities Act of 1906	Migratory Bird Conservation Act of 1929
Archeological Resources Protection Act of 1979	Migratory Bird Treaty Act of 1918
Archeological and Historical Preservation Act of 1974	Migratory Bird Habitat Protection (EO 13186) of 2001
Bald Eagle Protection Act of 1940	National Environmental Policy Act of 1969
Clean Air Act of 1970	National Historic Preservation Act of 1966
Clean Water Act of 1977	Native American Graves Protection and Repatriation Act of 1990
Coastal Barrier Improvement Act of 1990	Neotropical Migratory Bird Conservation Act of 2000
Coastal Barrier Resources Act of 1982	Noise Control Act of 1972
Coastal Wetlands Planning, Protection, and Restoration Act of 1990	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1996
Coastal Zone Management Act of 1972	North American Wetlands Conservation Act of 1989
Comprehensive Environmental Response, Compensation, and Liability Act of 1980	Oil Pollution Act of 1990
Consultation and Coordination with Indian Tribal Governments (EO 13175) of 2000	Outer Continental Shelf Lands Act of 1953
Emergency Planning and Community Right-to-Know Act of 1986	Pollution Prevention Act of 1990
Emergency Wetlands Restoration Act of 1986	Prime and Unique Farmlands, 1980 CEQ Memorandum
Endangered Species Act of 1973	Protection and Enhancement of the Cultural Environment (EO 11593) of 1971
Environmental Quality Improvement Act of 1970	Protection and Enhancement of Environmental Quality (EO 11991) of 1977
Estuaries and Clean Water Act of 2000	Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) of 1997
Estuary Protection Act of 1968	Protection of Cultural Property (EO 12555) of 1986
Estuary Restoration Act of 2000	Protection of Wetlands (EO 11990) of 1977
Exotic Organisms (EO 11987) of 1977	Reclamation Projects Authorization and Adjustments Act of 1992
Farmland Protection Policy Act of 1981	Recreational Fisheries (EO 12962) of 1995
Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898) of 1994	Resource Conservation and Recovery Act of 1976
Federal Emergency Management (EO 12148) of 1979	Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186) of 2001
Federal Facilities Compliance Act of 1992	Rivers and Harbors Acts of 1899 and 1956
Federal Land Policy and Management Act of 1976	River and Harbor and Flood Control Act of 1970
Federal Water Pollution Control Act of 1972	Safe Drinking Water Act of 1974
Federal Water Project Recreation Act of 1965	Submerged Land Act of 1953
Fish and Wildlife Conservation Act of 1980	Sustainable Fisheries Act of 1996
Fish and Wildlife Coordination Act of 1934	Toxic Substances Control Act of 1976
Flood Control Act of 1944	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
Floodplain Management (EO 11988) of 1977	Water Resources Development Acts of 1976, 1986, 1990, 1992, and 2007
Food Security Act of 1985	Water Resources Planning Act of 1965
Greening of the Government Through Efficient Energy Management (EO 13148) of 2000	Watershed Protection & Flood Prevention Act of 1954
Historic Sites Act of 1935	Water Pollution Control Act Amendments of 1972
Historical and Archeological Data-Preservation Act of 1974	Wild and Scenic River Act of 1968
Indian Sacred Sites (EO 13007) of 1996	Wilderness Act of 1964
Invasive Species (EO 13112) of 1999	
Land & Water Conservation Fund Act of 1965	
Magnuson-Stevens Fishery Conservation and Management Act of 1976	

(Note: this list is not complete or exhaustive.)	
Air Control Act	Louisiana Threatened and Endangered Species and Rare & Unique Habitats
Archeological Treasury Act of 1974	Protection of Cypress Trees
Louisiana Coastal Resources Program	Water Control Act
Louisiana Scenic Rivers Act of 1988	

ENVIRONMENTAL LAWS AND COMPLIANCE (*NEPA REQUIRED)

Federal projects must comply with Federal and state environmental laws, regulations, policies, rules and guidance. The team has coordinated and will continue to coordinate with Federal and state resource agencies during planning of the proposed action. Status of compliance with the various laws is presented below.

Bald and Golden Eagle Protection Act of 1940 (Bald Eagles)

The Bald and Golden Eagle Protection Act protects two eagle species. Bald eagles occur or occasionally occur in the proposed project area. Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on bald eagles.

Clean Air Act of 1970

The Clean Air Act (CAA) sets goals and standards for the quality and purity of air. It requires the Environmental Protection Agency to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The project area is in Calcasieu, Cameron and Vermilion Parishes, which are currently in attainment of NAAQS. The Louisiana Department of Environmental Quality is not required by the CAA and Louisiana Administrative Code, Title 33 to grant a general conformity determination.

Clean Water Act of 1977 – Section 401

The Clean Water Act (CWA) sets and maintains goals and standards for water quality and purity. Section 401 requires a Water Quality Certification from the Louisiana Department of Environmental Quality that a proposed project does not violate established effluent limitations and water quality standards. Section 401 compliance will be documented in the final report.

Clean Water Act of 1972 – Section 404(b)(1) (Wetlands)

The USACE administers regulations under Section 404(b)(1) of the CWA, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Potential project-induced impacts subject to these regulations will be evaluated during feasibility level design. A completed 404(b)(1) evaluation will be included in the final report.

Coastal Zone Management Act of 1972 (Coastal Zone Development)

The Coastal Zone Management Act provides for the management, beneficial use, protection and development of the nation's coastal resources by encouraging and assisting the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development. A Consistency Determination for the programmatic NED and the NER Plans, dated April 29, 2014, was provided to the Louisiana Department of Natural Resources (LDNR) for concurrence. By letter dated June 30, 2014, the LDNR provided programmatic concurrence that the project, at that stage of development (i.e., at a programmatic level), was consistent with the Louisiana Coastal Resources Program, but future phases of the project which may have coastal impacts would need to be reviewed as they were developed.

Hence, a revised Consistency Determination is included with the revised Draft Environmental Impact Statement (EIS) and contains a description of the proposed action, including a general description of the programmatic NED plan as well as a more detailed description of the feasibility-level NER plan presented in the revised Draft EIS. Following this project information, a programmatic analysis of the applicable Coastal

Use Guidelines for the NED plan is provided. Also provided is a more detailed feasibility-level analysis of the applicable Coastal Use Guidelines for the NER plan.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

An appropriate level of assessment for the presence of Hazardous, Toxic and Radioactive Waste (HTRW) is required for feasibility studies per Engineering Regulation 1165-2-132 HTRW Guidance for Civil Works Projects. HTRW includes any material listed as a "Hazardous Substance" under the CERCLA. Other regulated contaminants include those substances that are not included under CERCLA but pose a potential health or safety hazard, and are regulated. Examples include, but are not limited to, many industrial wastes, naturally occurring radioactive materials (NORM), many products and wastes associated with the oil and gas industry, herbicides, and pesticides.

Consistent with the CERCLA Current USACE practice is to prepare a Phase I Environmental Site Assessment (ESA) following ASTM Standard E 1527-05. A standard Phase I ESA is currently being prepared to identify potential Recognized Environmental Concerns (REC), the results of which will be documented in the Final EIS.

Petrochemical and other plants are located along the Calcasieu River Ship Channel and the Lake Charles, Westlake, and Sulphur industrial corridors. These facilities have the potential for chemical and other HTRW-type discharges. Several waterways in the project area are known to be contaminated with CERCLA-regulated constituents. Some of these waterways are located within and nearby the NED and NER project areas.

The programmatic NED Plan for hurricane and storm damage risk reduction will require additional NEPA and CERCLA documentation. Based on preliminary findings of an ongoing Phase I ESA, the NED Plan features would not impact or be impacted by any CERCLA regulated constituents.

The primarily undeveloped NER Plan area contains numerous oil and gas fields and individual production wells with associated waste pits, and pipelines. Preliminary findings of the ongoing Phase I ESA indicate the NED Plan features would not be impacted by HTRW or other CERCLA constituents.

The above preliminary findings will be verified once the Phase I ESA has been completed. The results of which will be presented in the final Report.

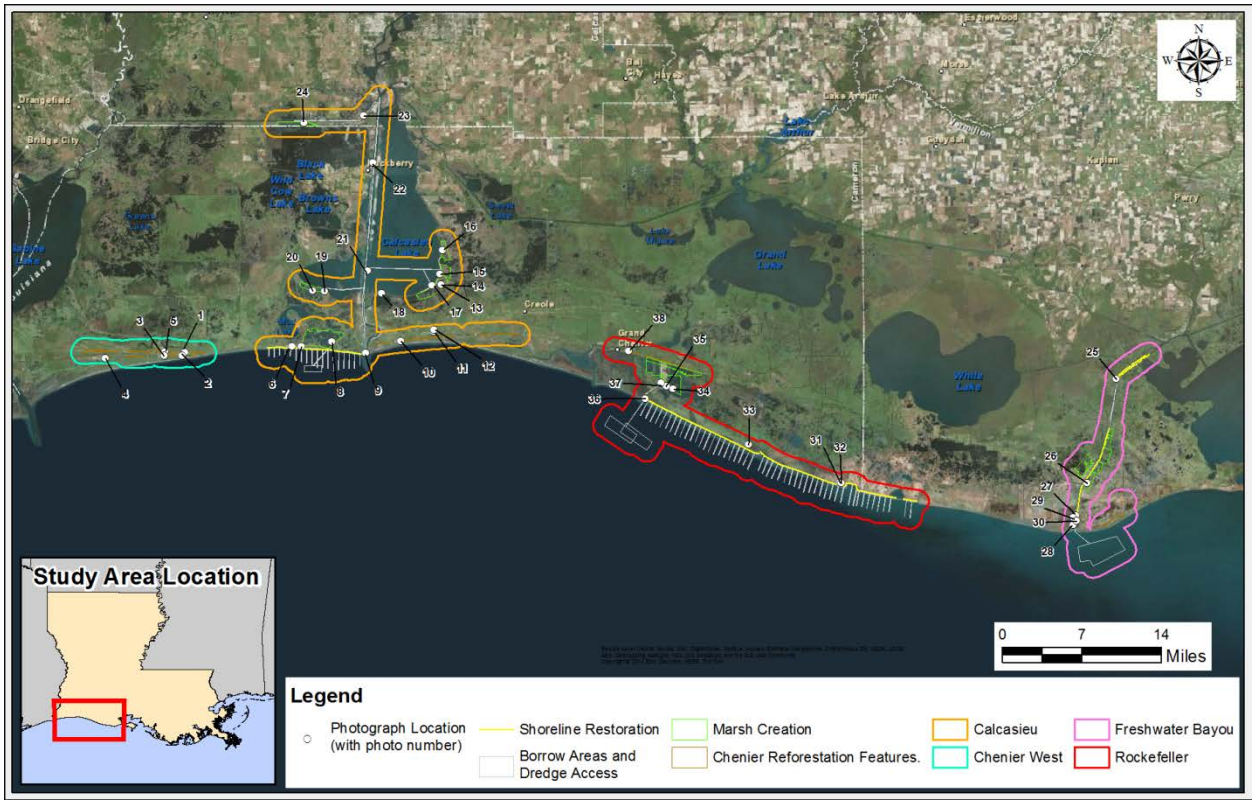

Figure 1. Restoration areas and points of interest photographed during the 3 February 2015 and 5 February 2015 aerial surveys.

BEM personnel performed an aerial survey of the Phase I buffer zones for each restoration area (Chenier West, Calcasieu, Rockefeller, and Freshwater Bayou) on 3 February 2015 and 5 February 2015 and documented mainly residential areas, marsh areas, oil and gas facilities, marinas, one dump site, and several unidentifiable drums/containers within the Phase I buffer zones for each restoration area (see Figure 1). Further investigation (i.e., pedestrian survey) is needed to determine if there are *recognized environmental conditions* associated with some of the aforementioned locations and items viewed during the aerial survey (see Table 1).

Table 1. Points of interest photographed during the aerial survey; these points will be investigated during the forthcoming pedestrian survey.

Site Number	Latitude	Longitude	Notes
4	29.75408	-93.72572	drum
7	29.77029	-93.43835	drum
10	29.7776	-93.29251	silo
11	29.789231	-93.244207	recycle center/dump
20	29.84121	-93.42261	drum
21	29.867346	-93.341841	drum
31	29.59649	-92.64969	metal box w/ legs and hatch ~4'x4'x5'
32	29.59576	-92.64734	another box
33	29.64556	-92.78358	tank

After a review of the Environmental Database Review (EDR) report generated for each of the four restoration areas, there appear to be no *recognized environmental conditions* within the restoration areas. The EDR

report included a search of available ("reasonably ascertainable") government records within the four restoration areas for the databases listed below:

FEDERAL RECORDS

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
Delisted NPL	National Priority List Deletions
NPL LIENS	Federal Superfund Liens
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
LIENS 2	CERCLA Lien Information
CORRACTS	Corrective Action Report
RCRA-TSDF	Resource Conservation and Recovery Act - Treatment, Storage and Disposal
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
HMIRS	Hazardous Materials Information Reporting System
DOT OPS	Incident and Accident Data
US CDL	Clandestine Drug Labs
US BROWNFIELDS	Listing of Brownfields Sites
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
LUCIS	Land Use Control Information System
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records of Decision
UMTRA	Uranium Mill Tailings Sites
ODI	Open Dump Inventory
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
US MINES	Mines Master Index File
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
RAATS	RCRA Administrative Action Tracking System
LEAD SMELTERS	Lead Smelter Sites
FEMA UST	Underground Storage Tank Listing
COAL ASH DOE	Steam-Electric Plant Operation Data
2020 COR ACTION	2020 Corrective Action Program List
PRP	Potentially Responsible Parties
EPA WATCH LIST	EPA Watch List
US FIN ASSUR	Financial Assurance Information
FEDERAL FACILITY	Federal Facility Site Information listing
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
US HIST CDL	National Clandestine Laboratory Register
CERC-NFRAP	CERCLIS No Further Remediation Planned
RCRA-LQG	RCRA Large Quantity Generators

RCRA-SQG	RCRA Small Quantity Generators
RCRA-CESQG	RCRA Conditionally Exempt Small Quantity Generators
RCRA NonGen / NLR	RCRA Non-Generators Do Not Presently Generate Hazardous Waste
ERNS	Emergency Response Notification System
TRIS	Toxic Chemical Release Inventory System
ICIS	Integrated Compliance Information System
FINDS	Facility Index System
RMP	Risk Management Program
US AIRS	US Aerometric Information Retrieval System

STATE AND LOCAL RECORDS

LA AUL	Conveyance Notice Listing
LA HIST DEBRIS	LDEQ Approved Debris Sites
LA SWRCY	Recycling Directory
LA HIST LUST	Underground Storage Tank Case History Incidents
LA LIENS	Environmental Liens
LA DEL SHWS	Deleted Potential & Confirmed Sites
LA VCP	Voluntary Remediation Program Sites
LA DRYCLEANERS	Drycleaner Facility Listing
LA BROWNFIELDS	Brownfields Inventory
LA CDL	Clandestine Drug Lab
LA COAL ASH	Coal Ash Disposal Sites
LA SHWS	Potential and Confirmed Sites List
LA SWF/LF	Solid Waste Facilities/Landfill Sites
LA DEBRIS	LDEQ Approved Debris Sites
LA UIC	Underground Injection Well Locations
LA LUST	Leaking Underground Storage Tank Incident Reports
LA UST	Underground Storage Tank
NY MANIFEST	Manifest
LA SPILLS	Spills and/or Releases
TX Ind. Haz Waste	Industrial and Hazardous Waste Database
LA NPDES	Louisiana Pollutant Discharge Elimination System
LA AIRS	Facilities with Air Permits Issued by the Air Permits Division
LA REM	Facilities Listed by the Underground Storage Tank and Remediation Division
LA ASBESTOS	Asbestos Demolition and Renovation Notification

TRIBAL RECORDS

INDIAN RESERV	Indian Reservations
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land
INDIAN VCP	Voluntary Cleanup Priority Listing

Interviews and information requests have been initiated with entities within each of the four restoration areas, no *recognized environmental conditions* have been reported within the restoration areas based upon information obtained thus far. Sources contacted for interviews and information requests are listed below:

United States Geological Survey
Louisiana Department of Natural Resources
Louisiana Oil Spill Coordinator's Office
U.S. Coast Guard
National Marine Fisheries Service

Cameron Parish Building Permits Office
Vermilion Parish Building Permits Office
Cameron Parish Fire District #10 (Johnson Bayou/Holly Beach) Fire Department
Vermilion Parish Fire Department
Cameron Parish Office of Emergency Preparedness
Vermilion Parish Office of Emergency Preparedness
Cameron Parish Police Jury
Vermilion Parish Police Jury
Cameron Parish Holly Beach Sewer Board District No. 10
Cameron Parish Sherriff's Office
Cameron Parish Tax Assessor's Office
Vermilion Parish Tax Assessor's Office
Louisiana Department of Environmental Quality

Endangered Species Act of 1973 (Threatened & Endangered Species)

The Endangered Species Act (ESA) is designed to protect and recover threatened and endangered (T&E) species of fish, wildlife and plants. The CEMVN is coordinating with the USFWS and the National Marine Fisheries Service (NMFS) to ensure for the protection of those T&E species under their respective jurisdictions. The USFWS identified in their September 20, 2013 email eleven listed T&E species, the Red-cockaded woodpecker, Piping plover, Red knot, Whooping crane, Gulf sturgeon, West Indian manatee, Green sea turtle, Hawksbill sea turtle, Kemp's Ridley sea turtle, Leatherback sea turtle and loggerhead sea turtle that are known to occur or occasionally occur in the project area. In addition, designated Piping plover critical habitat and Loggerhead critical habitat also occur within the project area. No plants were identified as being threatened or endangered in the project area. Based on review of existing data and preliminary field surveys, the MVN has determined that the proposed action *"may affect but will not likely adversely affect"* the piping plover or it's critical habitat, red knot, West Indian manatee, Gulf sturgeon, loggerhead and Kemps Ridley sea turtles; would have no effect on the green, leatherback, and hawksbill sea turtles or loggerhead critical habitat and would not adversely impact other species of concern that could potentially be found in the project area. As part of the revised draft EIS, a Biological Assessment (BA) has been prepared and provided to NMFS/USFWS for their concurrence on the aforementioned determinations.

Louisiana State Threatened and Endangered Species and Rare and Unique Habitat

The Louisiana Department of Wildlife and Fisheries Louisiana Natural Heritage Program lists T&E species, rare, unique and imperiled habitats in the State of Louisiana. Based on review of the LNHP online database, the following rare or unique habitats, animals and plants are found in the project area: Brackish marsh, coastal dune grassland, coastal live oak-hackberry forest, coastal prairie, freshwater marsh, red wolf, crested caracara, snowy plover, piping plover, Wilson's plover, common ground-dove, sandhill crane, diamondback terrapin, brown pelican, roseate spoonbill, glossy ibis, paddlefish, eastern spotted skunk, ornate box turtle, manatee, Gregg's amaranth, A milk-vetch, golden canna, dune sandbur, sand dune spurge, wedge-leaf prairie-clover, wedge-leaf whitlow-grass, slim spike-rush, punctuate cupgrass, narrow-leaved puccoon, grapefruit primrosewilow, saltflat-grass, blue water lily, roundleaf scarf-pea, Correll's false dragon-head, wand blackroot, Mexican hat, small's beaksedge, southern beaksedge, sand rose-gentian, brookweed, Elliott sida, Florida bully, powdery thalia, woolly honeysweet, sea oats (LDWF 2013). The CEMVN finds the NER TSP would have long term beneficial impacts on these rare and unique habitats and Louisiana T&E species.

Colonial Nesting Water Birds

The USFWS indicated in their January 9, 2009 coordination letter that the project area is known to support colonial nesting water birds (e.g., herons, egrets, ibis, night-herons and roseate spoonbills). Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no effect on colonial nesting water birds with implementation of BMPs and USFWS recommendations.

Farmland Protection Policy Act of 1981 (Farmland)

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact of Federal programs on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to requirements if they may irreversibly convert farmland to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. There are approximately 3,200 acres of soils that are classified as prime farmlands in the Lake Charles East levee alignment area (NED). The Lake Charles area is a heavily developed urban area and few areas are currently being used for agriculture or pastureland. Approximately 514 acres of soils classified as prime farmlands are present on chenier ridges that could be removed from current or future agricultural use as a result of proposed reforestation activities. In compliance with the Farmland Protection Policy Act (FPPA), the USACE will consult with the Department of Agriculture – Natural Resources Conservation Service (NRCS) to determine the precise acreages that would be impacted. By letter dated December 13, 2013 the NRCS concurs that impacts to prime and unique farmlands from the TSP will not "irreversibly" impact prime farmland and is therefore exempt from the rules and regulations of Section 1539-1549 of Farmland Protection Policy Act.

Fish and Wildlife Coordination Act of 1934 (Fish & Wildlife)

The Fish and Wildlife Coordination Act (FWCA) provides authority for the USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license or permit water resource development projects to first consult with the USFWS, NMFS and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. Section 2(b) requires the USFWS to produce a Coordination Act Report (FWCAR) that details existing fish and wildlife resources in a project area, potential impacts due to a proposed project and recommendations for a project. The revised draft FWCAR includes the USFWS positions and recommendations.

Magnuson-Stevens Fishery Conservation and Management Act of 1976 and the Magnuson-Stevens Act Reauthorization of 2006 (Essential Fish Habitat)

The law and its reauthorization govern marine fisheries management in the U.S. Essential Fish Habitat (EFH) would not intersect the proposed programmatic non-structural NED Plan. The CEMVN has determined that the more detailed feasibility NER Plan would have significant impacts to EFH by shifting existing shallow open water EFH to marsh EFH; shoreline protection habitat which will protect marsh habitat, and conversion of existing levee and adjacent shallow open water and fragmented marsh which would be converted to hydrologic/salinity control structure for remove of flood waters. Hence, there would be a net positive gain and overall estuarine benefits of higher quality marsh EFH.

Marine Mammal Protection Act of 1972 (Marine Mammals)

The Marine Mammal Protection Act (MMPA) protects whales, dolphins, sea lions, seals, manatees and other species of marine mammals. The CEMVN finds the TSP would have no effect on marine mammals that may occasionally be found in the project area. To avoid "takings" of the West Indian manatee and ensure compliance with the MMPA, the CEMVN commits that 1) all construction personnel will be educated about the MMPA, ESA and species protected by the MMPA, 2) a search for manatees and dolphins in the project area and mitigation areas would be conducted before construction, and 3) best management practices detailed in appendix A to avoid or minimize potential entrapment of manatees and dolphins during construction would be implemented.

Migratory Bird Treaty Act of 1918 and Migratory Bird Conservation Act of 1929 (Migratory Birds)

The Migratory Bird Treaty Act (MBTA) and the Migratory Bird Conservation Act (MBCA) protect migratory birds and their habitat. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat. Seven potentially active colonial nesting water bird rookeries may exist within 1,000 feet of the proposed NER and non-structural features. USFWS and USACE biologists will survey the area before construction to confirm active rookery locations. If active rookeries exist within 1,000 feet or

there are active brown pelican nesting colonies within 2,000 feet of the proposed action, this could be a project constraint. USFWS guidelines would be followed to avoid adverse impacts to these species

National Historic Preservation Act of 1966 (Cultural and Historic Resources)

Section 106 of the National Historic Preservation Act (NHPA) and the implementing regulations (36 CFR part 800) require federal agencies to take into account the effects of their undertakings on historic properties, including any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places, and to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment. Federal agencies are required to consult with other parties throughout the Section 106 process, including the State Historic Preservation Officer (SHPO) and Indian Tribes that attach traditional religious and cultural significance to historic properties that may be affected by an undertaking. Taking into account the views of consulting parties and the public, the federal agency will determine how to resolve any adverse effects to historic properties prior to the final decision-making. Section 106 consultation has been initiated, and documentation of the Section 106 process will be included in the final report.

Tribal Consultation (Tribal Interests)

In partial fulfillment of E.O. 13175 ("Consultation and Coordination With Indian Tribal Governments"), NEPA and Section 106, consultation has been initiated with the following federally recognized Tribes: Alabama-Coushatta Tribe of Texas, Caddo Nation of Oklahoma, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Mississippi Band of Choctaw Indians, Quapaw Tribe of Oklahoma, Seminole Nation of Oklahoma, Seminole Tribe of Florida and Tunica-Biloxi Tribe of Louisiana. CEMVN has provided Tribes with a summary of the study authority and documentation of completed cultural resource investigations and previously recorded archaeological sites and standing structures within a one-mile buffer of the proposed alternatives, offering Tribes the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands. Documentation of tribal consultation will be included in the final report.

Wild and Scenic River Act of 1968 (Rivers)

The Wild and Scenic Rivers Act establishes a National Wild and Scenic Rivers System. The Louisiana Scenic Rivers Act recognizes and implements the 1968 Federal law, to preserve, protect and enhance the wilderness qualities, scenic beauties and ecological regimes of rivers and streams. Any construction within 100 feet of a scenic stream requires a scenic streams permit. There are no scenic rivers within the project area.

Executive Order 11514, Protection and Enhancement of Environmental Quality

EO 11514 directs Federal agencies to "initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals." The TSP complies with EO 11514.

Executive Order 11988, Floodplain Management

EO 11988 directs agencies to avoid development in floodplains to the maximum extent feasible. The programmatic NED Plan would provide reduce the risk of storm surge flooding to existing structures within the floodplain. The CEMVN is also providing storm surge information to inform the flood Plain Administrators in Calcasieu, Cameron and Vermilion Parishes in their floodplain management implementation. The more detailed NER Plan would have no significant adverse impacts on the floodplain or its management. Hence, the proposed action complies with EO 11988.

Executive Order 11990, Protection of Wetlands

EO 11990 directs Federal agencies to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Mitigation planning was integrated into the planning by considering, individually and collectively, each of the NEPA mitigation actions of avoiding, minimizing, reducing and rectifying potential adverse impacts to wetlands to the extent practicable.

Implementing the both the programmatic NED Plan and the more detailed NER Plan would not require any compensatory mitigation. For the NER Plan, unavoidable project-induced impacts to wetlands, such as placement of shoreline protection features and others have been avoided or will be mitigated in-kind by the ecosystem restoration benefits. Hence, the proposed action complies with the EO 11990.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

EO 12898 requires agencies to make achieving environmental justice (EJ) part of their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of programs, policies and activities on minority populations and low-income populations. Potential EJ issues have been considered throughout planning. As part of the NEPA process, public and scoping meetings were held and attention was given to EJ issues. CEMVN encourages any interested parties to inform the agency of potential EJ concerns.

Executive Order 13112, Invasive Species

EO 13112 directs Federal agencies to prevent the introduction of invasive species; provide for their control; and minimize the economic, ecological and human health impacts that invasive species cause. The TSP is consistent with EO 13112 to the extent practicable and permitted by law and subject to the availability of appropriations, and within Administration budgetary limits. Relevant programs and authorities to prevent the introduction of invasive species would be used during construction. The CEMVN will not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless the CEMVN has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm would be taken in conjunction with the actions.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

EO 13186 directs Federal agencies to take actions to further implement the Migratory Bird Treaty Act. The TSP has been evaluated for potential effects on migratory birds, with emphasis on species of concern. Many important habitats in the project area provide migratory bird shelter, nesting, feeding and roosting habitat.

SOUTHWEST COASTAL LOUISIANA
REVISED INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex K

Threatened and Endangered Species

CONTENT

1. THREATENED AND ENDANGERED SPECIES 3

SPRAGUE'S PIPIT 3

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LEATHERBACK SEA TURTLE 8

LOGGERHEAD SEA TURTLE 8

2. REFERENCES 10

1. THREATENED AND ENDANGERED SPECIES

Historic and Existing Conditions

Eleven threatened and endangered species and one candidate species are known to occur or occasionally enter the Southwest Coastal Louisiana Project area (See Table 1). The proposed project area also contains Piping plover critical habitat. Personal coordination with USFWS staff concluded that a "programmatic Biological Assessment" is not required, therefore a Biological Assessment (BA) will be prepared and informal consultation with NMFS/USFWS concluded upon development of subsequent NEPA analysis prior to implementing the TSP.

Table 1. Listed and Candidate Species within the Project Area

Species	Acadia Parish	Calcasieu Parish	Cameron Parish	Vermillion Parish
*Sprague's Pipit	Candidate	Candidate	Candidate	Candidate
Red-Cockaded Woodpecker		Endangered		
Piping Plover			Threatened/ Critical habitat	Threatened/ Critical habitat
Red Knot			Threatened	Threatened
**Whooping Crane				Threatened
West Indian Manatee			Endangered	Endangered
Gulf Sturgeon			Threatened	Threatened
Green Sea Turtle			Threatened	Threatened
Hawksbill Sea Turtle			Endangered	Endangered
Kemp's Ridley Sea Turtle			Endangered	Endangered
Leatherback Sea Turtle			Endangered	Endangered
Loggerhead Sea Turtle			Threatened Critical habitat	Threatened Critical habitat

* Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list

**This is a nonessential population which is considered "threatened". However, the ESA's section 7 consultation regulations do not apply.

Sprague's Pipit: Candidate species

The Sprague's pipit, is a candidate species for federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. The Sprague's pipit is known to or believed to occur in all parishes within the project area.

Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds (personal coordination USFWS Brigette Firmin).

Red-Cockaded Woodpecker: Endangered species

The red-cockaded woodpecker (RCW) was federally listed as endangered in 1970. Red-cockaded woodpeckers are known to, or believed to occur within the proposed project area, specifically in Calcasieu Parish. Deforestation for timber harvesting and habitat fragmentation for agricultural purposes has been the driving factor in reducing its habitat. Approximately 1% of their range remains. Mature pines in open upland stands are the preferred habitat of the RCW, however habitat selection varies regionally. Observations in Louisiana suggest significant use of bottomland hardwoods (Jones and Hunt).

The RCW is a small bird with a ladder-back, large white cheek patches and a black cap.

The male possesses a tiny patch of red feathers at the margin of the black cap and white cheeks. They roost and nest in cavities they sculpt primarily in pine trees. They feed on arthropods they gather from under tree bark. RCW can be found in Calcasieu Parish year round.

Piping Plover: Threatened species

Hunting in the early 1900s resulted in a drastic reduction of the piping plover population. Ongoing destruction of historical nesting sites further reduced plover populations (USFWS 1988). On December 11, 1985, the USFWS designated the piping plover as endangered in areas of the Great Lakes watershed. The piping plover was designated as threatened, except in those areas where it is listed as endangered. The Piping plover is listed as threatened in Louisiana as well as several other states.

In July of 2001, the USFWS designated specific areas in the United States as critical habitat for wintering piping plovers (Federal Register / Vol. 66, No. 132, 10 July 2001). Piping plover critical habitat is defined by the USFWS as "those elements essential for the primary biological needs of foraging, sheltering, roosting, and the physical features necessary for maintaining the natural processes that support those habitat components. These primary elements are found only in coastal areas with intertidal beaches or flats that are associated with dunes systems." The USFWS designated a total of 1,798 miles (165,211 acres) of shoreline along the Gulf of Mexico and Atlantic coasts as critical wintering

habitat. Critical habitat in Louisiana encompasses 24,950 acres along 342.5 miles of shoreline, which is most of the coast of Louisiana. Piping plovers winter in Louisiana but do not nest on Louisiana's coast. They arrive from their northern breeding grounds as early as late July and may be present for 8 to 10 months of the year.

In 2006, an international piping plover breeding and wintering census was conducted. The results of the census showed that the piping plovers were found wintering primarily in Texas (53.8%), Florida (11.7%) and the Bahamas (10.7%). The results of the Census showed only 5.8% found wintering in Louisiana (Elliott-Smith et al 2006). In Louisiana, the 2006 census takers recorded 226 piping plovers, almost half of the 2001 census numbers. The substantial decline in numbers can be attributed to habitat damage incurred by Hurricanes Katrina and Rita. Sites in Terrebonne and Cameron Parishes had some of the largest populations of piping plovers in the state: Raccoon (Last) Island, 39 birds; Whiskey Island, 31 birds; Smith Bayou to West Jetty, 35 birds.

Red Knot: Threatened species

The red knot is a medium-sized shorebird about 9 to 11 inches in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot can be found in Louisiana during the winter months (generally October through March).

In the southeastern United States, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms and roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams, a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion and shoreline stabilization development, disturbance by humans and pets, and predation (personal coordination USFWS Brigette Firmin).

Whooping Crane: Threatened species (nonessential experimental population (NEP))

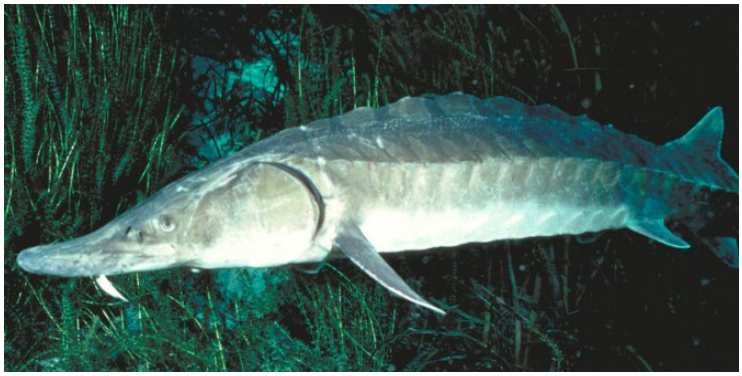
The whooping crane was listed as endangered in 1970 by the U. S. Fish and Wildlife Service. A NEP was introduced into historic southwestern Louisiana habitat on the state-owned White Lake Wetlands Conservation Area in Vermilion Parish, Louisiana. This reintroduced population was designated as NEP under section 10(j) of the Endangered Species Act of 1973 (ESA), as amended. A NEP population is a reintroduced population believed not to be essential for the survival of the species, but important for its full recovery and eventual removal from the endangered and threatened list. These populations are treated as "threatened" species except that the ESA's section 7 consultation regulations do not apply.

The whooping crane is a large white bird with black wing tips, red on forehead and cheeks, bill and legs are dark gray and eyes are yellow. Whooping cranes nest on the ground in marshy areas with bulrushes, cattails

and sedges and will sometimes roost in shallow waters. They feed on insects, crabs, clams, crayfish, frogs, rodents, small birds, berries, acorns and other wild fruit (USFWS).

West Indian Manatee: Endangered species

The manatee was listed as an endangered species in 1967 by the USFWS. Manatees inhabit coastal areas from Florida to the Greater Antilles and suitable habitats in Central and South America. The manatees' range is generally restricted to the southeastern United States; individuals occasionally range as far north as Massachusetts and as far west as Texas. On occasion they have been observed in eastern Louisiana waters. Preferred manatee habitat includes abundant submerged aquatic vegetation, such as sea grasses, which are limited to shallow water near shore, because deep water limits the amount of light which can penetrate the water and reach the vegetation (USFWS 2008). They can feed in brackish or salt water, but require a fresh water source, such as estuaries or natural springs, for drinking. The manatee is known to or believed to occur in Cameron and Vermilion Parishes within the project area.



Gulf Sturgeon: Threatened species

On September 30, 1991, the Gulf sturgeon was listed as a threatened species under the Endangered Species Act (ESA) (56 FR 49653). The Gulf sturgeon is known to or believed to occur in Cameron and Vermilion Parishes within the project area. Gulf sturgeons are rather large fish with bony plates and a hard extended snout. They are brackish/marine water bottom feeders that eat primarily macro invertebrates. Gulf sturgeons spawn in fresh water coastal rivers during the warmer months and move to marine waters during the cooler months. Some of the primary causes of the species' decline are habitat loss due to the construction of water control structures, dredging, poor water quality and irrigation (NOAA-6).

Green Sea Turtle: Threatened species

Green sea turtles were listed as Threatened on July 28, 1978. The green sea turtle is known or believed to occur in Cameron and Vermillion Parishes within the project area. Green sea turtles are found worldwide in oceans and gulfs with water temperatures greater than 20° C. During their first year of life they are primarily carnivorous, feeding mainly on invertebrates. As adults they feed almost exclusively on sea grasses growing in shallow water flats (Fritts et al. 1983). Historically, green sea turtles were fished off the Louisiana coast (Rebel 1974, in Fritts et al. 1983), but exploitation and incidental drowning in shrimp trawls led to the decline of this species and its listing as a threatened species. Sightings or strandings are rare in Louisiana, but do occur. Strandings are defined as turtles that wash ashore, dead or alive, or are found floating dead or alive (generally in a weakened condition). NMFS' records show 6 plus strandings in 2011, 9 plus in 2012 and in 2013 4 plus (NOAA-1).

Hawksbill Sea Turtle: Endangered species

Hawksbill sea turtles were listed as endangered in 1970. The Hawksbill sea turtle is known or believed to occur in Cameron and Vermillion Parishes within the project area. Hawksbills regularly occur in the Gulf of Mexico but mainly in Texas They feed on animals associated with coral reefs, sponges, other invertebrates and algae. There is no record of Hawksbill strandings along Louisiana shorelines (NOAA-2).

Kemp's Ridley Sea Turtle: Endangered species

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970. Inshore areas of the Gulf of Mexico appear to be important habitat for the Kemp's ridley sea turtle. Kemp's ridley turtles in the Gulf of Mexico tend to be concentrated around major river mouths (Frazier 1980). Ridleys are commonly captured by shrimpers off the Texas coast, as well as in heavily trawled areas off the coasts of Louisiana and Alabama (Carr 1980, Pritchard and Marquez 1973). Kemp's ridley turtles are thought to be the most abundant turtle off the Louisiana coast (Gunter 1981, Viosca 1961) as well as the most endangered of the sea turtles. Occurrence of ridleys in bays and estuaries along the Louisiana coast would

not be unexpected, since many of their primary food items occur there.

The nesting season for the Kemp's ridley is April through July. The possibility of Kemp's ridley sea turtles nesting in Louisiana has been suggested (Hildebrand 1981, Viosca 1961), but no actual documentation of nesting exists. However, based on information obtained from NMFS, Kemp's ridley sea turtle strandings on the Louisiana coast have been documented and have increased since 2011. In 2013 at least 145 plus Kemp's ridley sea turtles were recorded along the Louisiana coast compared to 104 plus in 2011. The majority of the sightings were in the spring months and approximately half of the 2013 sightings were along the western Louisiana coastline within the proposed project area (NOAA-3).

Leatherback Sea Turtle: Endangered species

The Leatherback sea turtle was listed as endangered in 1970. It is known to or believed to occur in Cameron and Vermillion Parishes within the project area. Leatherbacks feed on soft-bodied prey like jellyfish. Adult leatherbacks have been sighted in the Gulf of Mexico; however, only one stranding has been recorded along the Louisiana shoreline (NOAA-4).

Loggerhead Sea Turtle: Threatened species

The loggerhead was listed as threatened in 1978 by the USFWS. The loggerhead turtle is distributed worldwide in temperate and tropical waters. Nesting is from April through August, with 90 percent of the nesting effort on the gulf coast, occurring on the south-central coast of Florida (Hildebrand 1981). Nesting in Louisiana is limited almost exclusively to the Chandeleur Island. Loggerhead strandings, although few, have been reported along the Louisiana coast. NMFS' records show 19 plus strandings in 2011, 3 plus in 2012 and 6 plus in 2013 (NOAA-5).

The loggerhead's diet includes molluscs, shrimp, crabs, sponges, jellyfish, squid, sea urchins, and basket stars (Caldwell et al. 1955, Hendrickson 1980). Landry (1986) suggested that they may also feed on the by-catch from shrimp trawling. Adult loggerheads feed in waters less than 50 meters in depth, while the primary foraging areas for juveniles appear to be estuaries and bays (Rabalais and Rabalais 1980).

On July 10, 2014 Loggerhead Critical Habitat (*Sargassum* habitat) issued a final rule to designate critical habitat for the Northwest Atlantic Ocean Distinct Population Segment (DPS) of the loggerhead sea turtle (*Caretta caretta*) within the Atlantic Ocean and the Gulf of Mexico pursuant to the Endangered Species Act of 1973, as

amended (ESA). Loggerhead critical habitat exists in the southern (offshore) portion of the SWC project area (see **Figure 4-2** below). This critical habitat expands the entire length of the project (west to east) and the closest points range from approximately 4 miles to 9 miles offshore.

Biological Assessment

I. INTRODUCTION

The U.S. Army Corps of Engineers (USACE), New Orleans District (MVN), has prepared this Biological Assessment (BA) to evaluate the potential impacts associated with the proposed hurricane and storm surge damage risk reduction measures and ecosystem restoration features within Calcasieu, Cameron, and Vermilion Parishes in southwest Louisiana.

The low elevation and proximity to the Gulf of Mexico places the unique environment and cultural heritage of southwest Louisiana communities at risk from storm surge flooding and coastal erosion. Land subsidence and rising sea level is expected to increase the potential for coastal flooding, shore erosion, saltwater intrusion, and loss of wetlands and chenier habitats.

II. ACTION AREA

The project area (**Figure 2-1**) is located in southwest Louisiana and includes all of Calcasieu, Cameron, and Vermilion parishes and small portions of Beauregard, Jefferson Davis, and Iberia parishes encompassing approximately 4,700 square miles.

Cameron Parish is located in the southwest corner of Louisiana. The southern boundary of the parish is the Gulf of Mexico. Eighty-two percent of Cameron Parish is coastal marshes. Geographically, it is one of the largest parishes in Louisiana. The parish is chiefly rural and the largest communities are Cameron and Hackberry. Cameron is located along Louisiana Highway 82 (LA-82), while Hackberry is located along LA-27. Other smaller communities include Creole, Johnsons Bayou, and Holly Beach.

Calcasieu Parish is located due north of Cameron Parish. The town of Lake Charles is the parish seat, which is the largest urban area in the project area. Only a small portion of the parish is located in the coastal zone.

Vermilion Parish is located due east of Cameron Parish. The southern boundary of the parish is the Gulf of Mexico. Large expanses of Vermilion Parish are open water (lakes, bays, and streams). Approximately 50 percent of the land is coastal marshes. The parish is chiefly rural and the town of Abbeville is the parish seat as well as the largest urban area in the parish. Other communities include Delcambre, Kaplan, and Gueydan, which are all located along LA-14 in the northern part of the project area. Pecan Island and Forked Island are smaller communities, both located along LA-82 in lower Vermilion Parish. Located along LA-333, Intracoastal City is the nearest access to Vermilion Bay and the Gulf of Mexico in this region and supports the area's oil and shrimp industries.

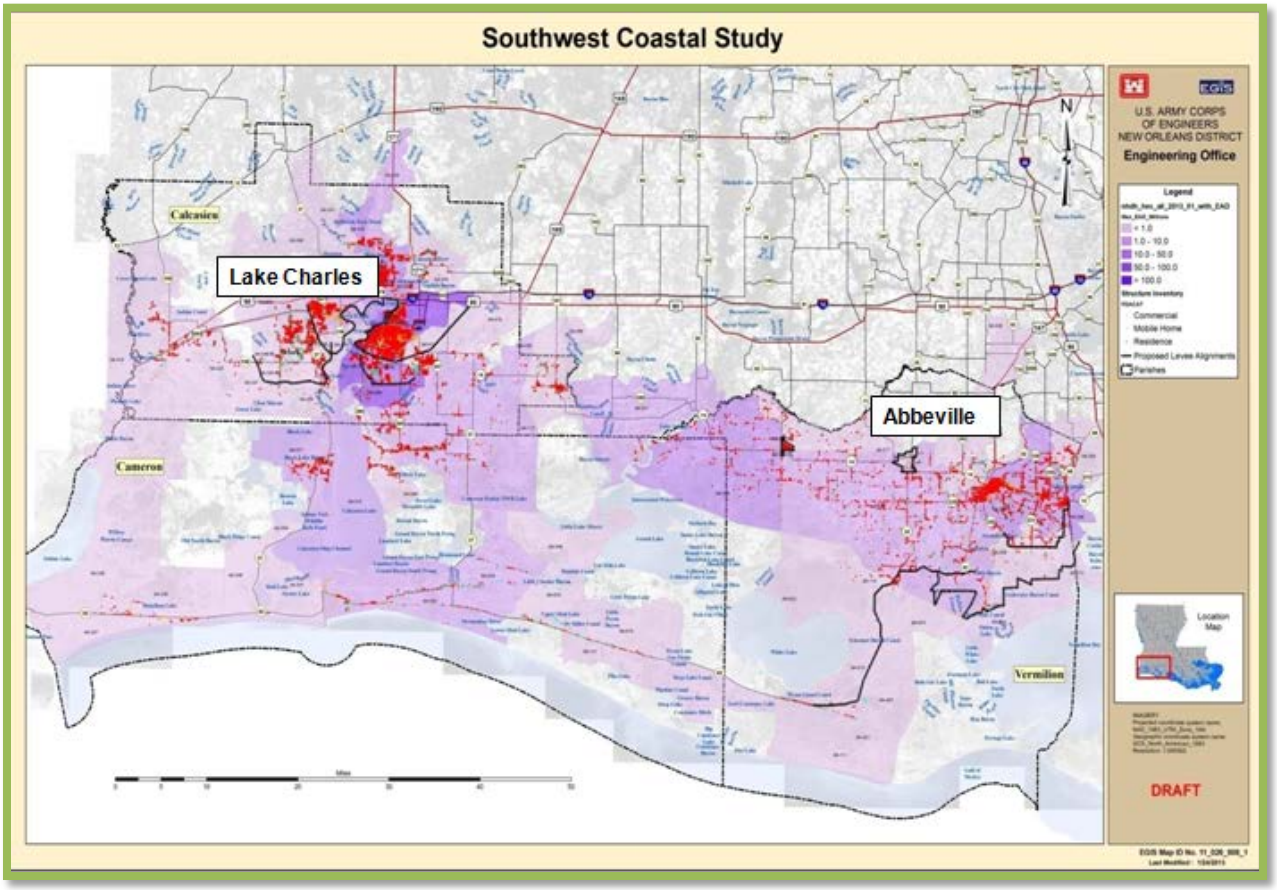


Figure 2-1 SWC Project Area

III. PROJECT DESCRIPTION

The NED tentatively selected plan (TSP) is programmatic and nonstructural. The program has been developed to address damages associated with hurricane and coastal storm surge flooding in Calcasieu, Cameron and Vermillion Parishes. The NED TSP is subject to parish-specific codes and regulations, additional NEPA compliance, and participation agreements. Consultation would be reinitiated upon further design of the NED plan and during preparation of additional NEPA compliance. Details of the NED TSP are below and in Figures 3-1:

- Nonstructural measures include:
  - Elevating residential structures*
  - Flood proofing non-residential structures (public and commercial facilities)*
  - Building small berms around warehouses
  - Potentially acquiring structures

  (* Note that some residential structures could be flood-proofed and some commercial structures could be elevated)

- Structures eligible for nonstructural measures have first-floor elevations at or below the 25-year flood zone, based on year 2025 hydrology. Eligible structures would be raised to the 100-year base flood elevation based on year 2075 hydrology.

- The TSP would reduce flood risk for 4,952 residential and non-residential structures (4,219 residential; 396 non-residential; 337 warehouses).

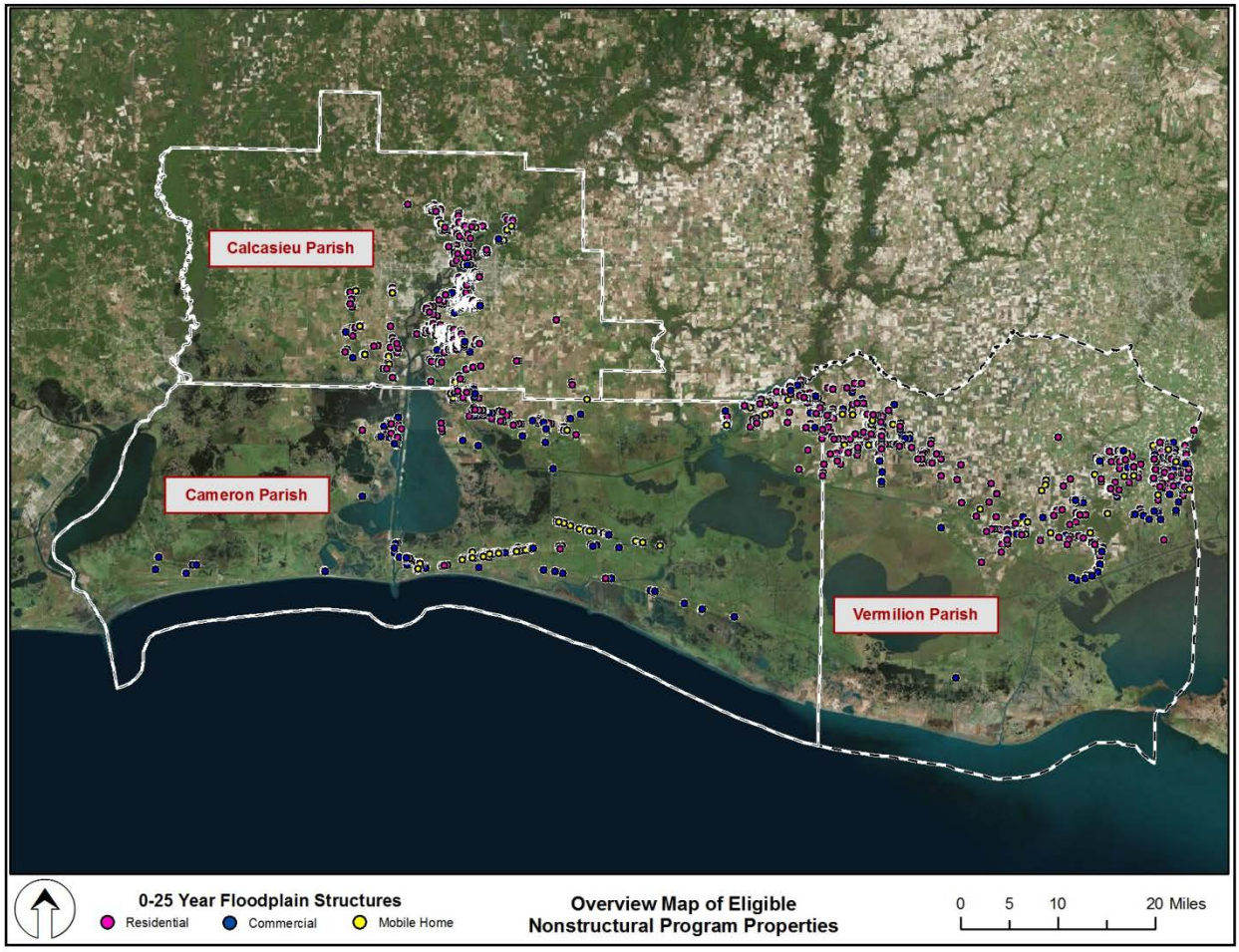


Figure 3-1 NED Eligbible Properties for Nonstructural Measures

The NER TSP is Small Integrated Restoration (Plan CM-4), a comprehensive ecosystem restoration plan addressing land loss problems and ecosystem degradation. The plan is cost effective, and is the least cost comprehensive best buy plan. The plan would minimize land loss; enhance plant productivity by reducing major stressors; and will reinforce and protect critical landscape features. Details of the TSP are listed below and in Figures 3-2 and 3-3:

A total of 51 ecosystem restoration features

- 9 marsh restoration features
- 35 chenier reforestation features
- 5 shoreline protection features
- 1 hydrologic / salinity control feature
- The Calcasieu Ship Channel Salinity Barrier Navigation Study is recommended as an additional long-range study

Details of the construction of the NER plan features are included in the Enclosures section (**Annex A**).

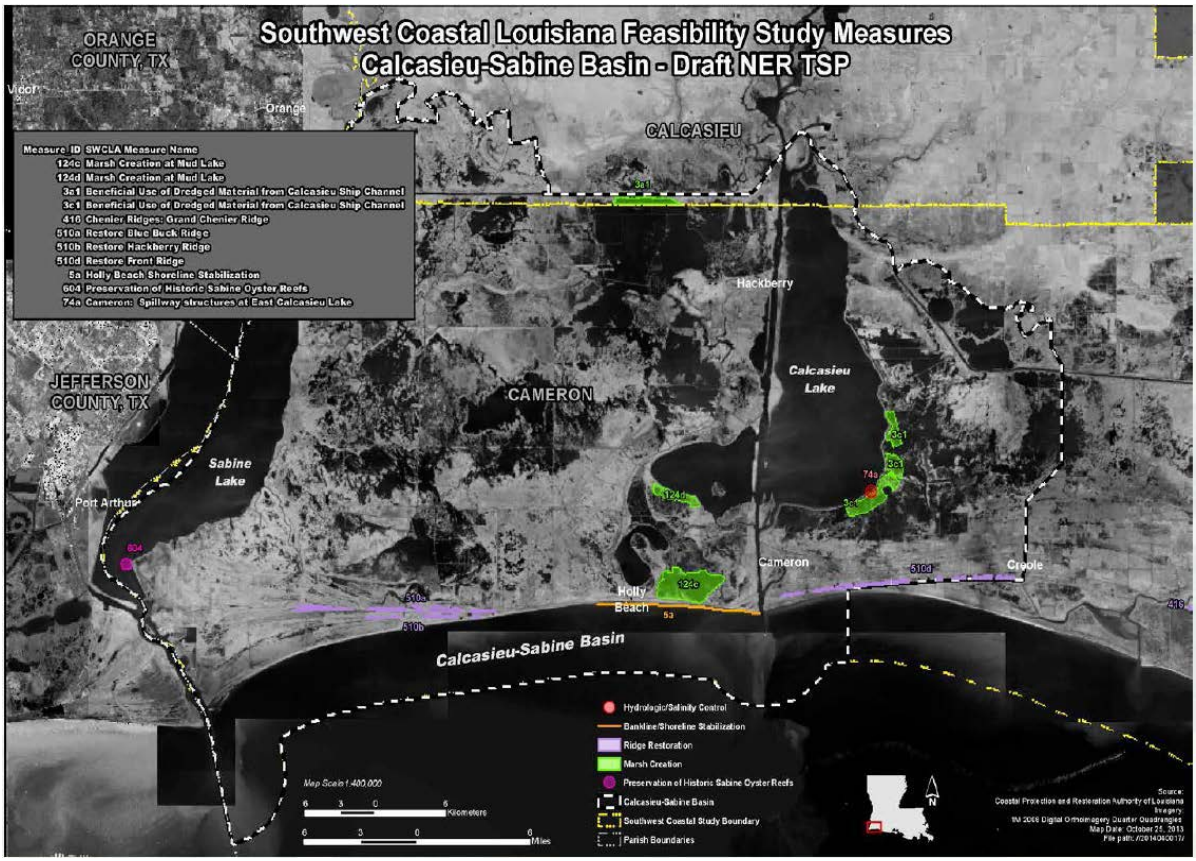


Figure 3-2 NER TSP features (Calcasieu)

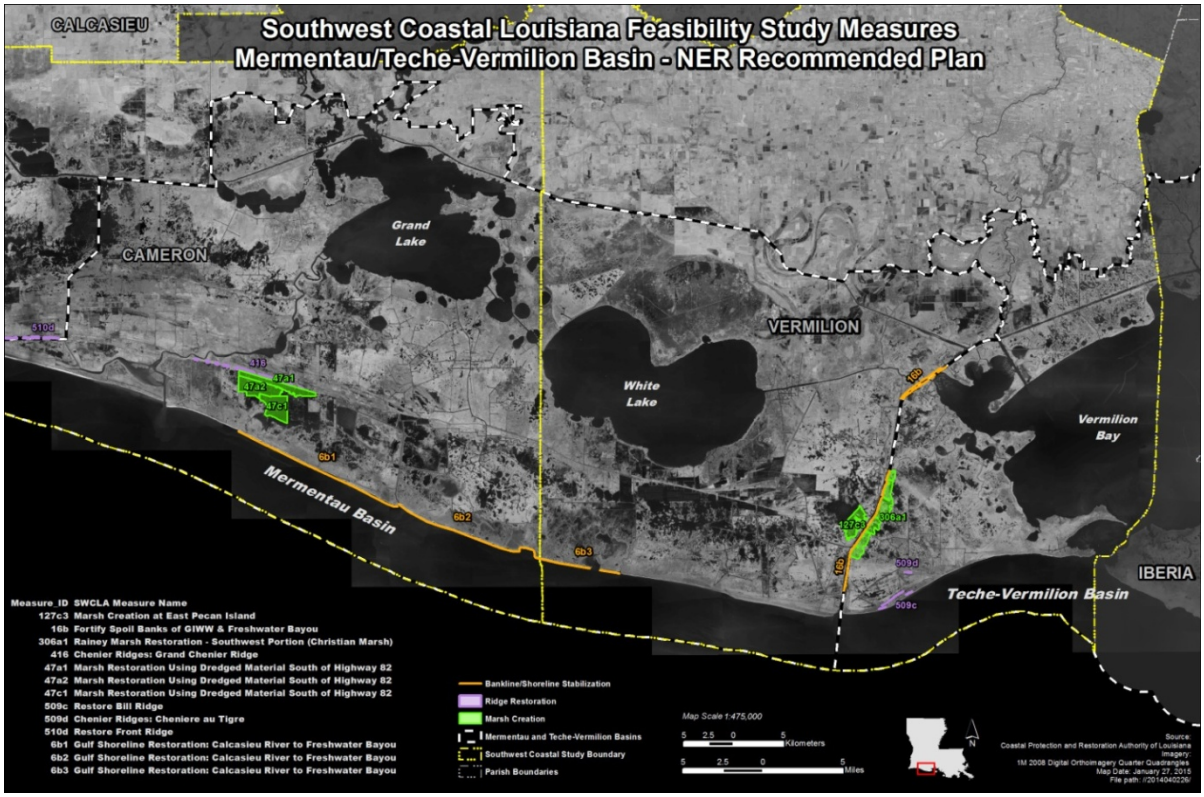


Figure 3-3 NER TSP features (Mermentau)

IV. SPECIES CONSIDERED

Eleven threatened or endangered species and one candidate species are known to or believed to occur within the SWC project area (**Table 4-1**). With the exception of the red-cockaded woodpecker (*Picoides borealis*), all of the species provided in **Table 4-1** below were listed in the November 2013 USFWS Draft Fish and Wildlife Coordination Act Report (USFWS 2013). Although the red-cockaded woodpecker may occur in Calcasieu Parish, it is unlikely to be impacted by any SWC TSP features as the habitat it is dependent upon is not found near the project features and the construction activity would be minimal and localized.

Cetaceans

A total of 28 cetaceans have been reported in the Gulf of Mexico waters (Davis et al. 2002). Of these, five Mysticeti (e.g., baleen whales including blue whale (*Balaneoptera musculus*), humpback whale (*Megaptera novaeangliae*), finback whale (*Balaenoptera physalus*), and sei whale (*Balaenoptera borealis*); and Odontoceiti (e.g., toothed whales, including sperm whale (*Physeter macrocephalus*) have been reported in the Gulf of Mexico and all are listed as endangered species. Infrequent, shallow water, historical sightings and strandings in the Gulf of Mexico of these endangered cetaceans suggest that most of these species are rare, accidental, or uncommon in this area (Davis et al. 2002). All whales are principally marine deepwater species and would not likely be impacted by the SWC TSP.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was removed from the list of Threatened and Endangered species on 8 August 2007. Bald eagles nest in Louisiana from October through mid-May and typically nest in mature trees (such as bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water (USFWS 2013). The bald eagle continues to be protected under the Migratory Bird Treaty Act of 1918 (MBTA) and the Bald and Golden Eagle Protection Act. Forested portions of the project area may provide habitat for the bald eagle. Most active bald eagle nesting sites have been historically located to the east of the SWC project area (source: http://www.lsuagcenter.com/en/communications/publications/agmag/Archive/2002/Spring/Bald+Eagles+Make+Comeback+in+South+Louisiana.htm). No known nests are located near any project features, however, if an eagle's nest is found, a no-work zone of 660 feet must be implemented and the Corps must be immediately notified.

Brown Pelican and Colonial Nesting Water Birds

The brown pelican (*Pelecanus occidentalis*) was removed from the list of Threatened and Endangered species on 17 December 2009. Their nests continue to be protected under the Migratory Bird Treaty Act (MBTA) of 1918. The brown pelican and a variety of colonial nesting water birds including but not limited to: herons, egrets, ibis, anhinga, double crested cormorants, and roseate spoonbill may nest within the project area. In general, the nesting season for these species runs from February 15 through September 1. The area is also known to support various species of shore birds including but not limited to: Sanderlings, sandpipers, gulls, and terns. These birds and their nests are protected under the MBTA and adverse impacts would be avoided. No known rookeries are located near any project features, however, if any nests are found, a no-work zone of 1,000 feet would be implemented. Additionally, if needed, a bird abatement plan would be developed and implemented, in coordination with USFWS, to deter colonial nesting water birds and shore birds from nesting within project boundaries.

Bottlenose Dolphin

The western north Atlantic bottlenose dolphin (*Tursiops truncatus*) populations found along the mid-Atlantic coast have been designated as depleted under the Marine Mammal Protection Act (MMPA) and, therefore, are stringently managed (NOAA 2015). In addition, the National Marine Fisheries Service (NMFS) has classified five U.S. stocks of bottlenose dolphins as *"strategic"* stocks, they are: Eastern Gulf of Mexico Coastal; Western Gulf of Mexico Coastal; Northern Gulf of Mexico Coastal; Gulf of Mexico Bay, Sound and Estuarine; and Western North Atlantic Coastal (NOAA 2015). Atlantic bottlenose dolphins inhabit temperate and tropical waters, and are found in the United States from Cape Cod to the Gulf of Mexico (IMMS 2015).

These marine mammals are protected under the MMPA of 1972 and therefore impacts should be avoided. **Annex B** provides entrapment prevention measures for the Atlantic bottlenose dolphins.

Table 4-1 Threatened and Endangered Species within the SWC Project Area

	Common Name	Scientific Name	Critical Habitat	Agency	Status
Birds	*Sprague's Pipit	*Anthus spragueii*		USFWS	Candidate
	red-cockaded woodpecker	*Picoides borealis*		USFWS	endangered
	piping plover	*Charadrius melodus*	yes	USFWS	threatened
	rufa red knot	*Calidris canutus rufa*		USFWS	threatened
	**whooping crane	*Grus americana*		USFWS	endangered
Fishes	Gulf sturgeon	*Acipenser oxyrinchus desotoi*		NOAA/NMFS	threatened
Mammals	West Indian manatee	*Trichechus manatus*		USFWS	endangered
Reptiles	green sea turtle	*Chelonia mydas*		NOAA/NMFS	threatened
	Kemp's ridley sea turtle	*Lepidochelys kempii*		NOAA/NMFS	endangered
	leatherback sea turtle	*Dermochelys coriacea*		NOAA/NMFS	endangered
	loggerhead sea turtle	*Caretta caretta*	yes	NOAA/NMFS	threatened
	hawksbill sea turtle	*Eretmochelys imbricata*		NOAA/NMFS	endangered

* Candidate species are those taxa for which the USFWS has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list.

**This is an *"experimental population, nonessential"* which is considered *"endangered."* Section 7 of the Endangered Species Act consultation regulations do not apply.

Sources:
http://ecos.fws.gov/ecos/home.action
http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm

The SWC TSP could potentially impact the piping plover (*Charadrius melodus*), rufa red knot (*Calidris canutus rufa*), West Indian manatee (*Trichechus manatus*), Gulf sturgeon and sea turtles. The project area encompasses critical habitat for the piping plover and for the loggerhead sea turtle (*Caretta caretta*). Only a very small area in the extreme southern off-shore portion of the project area encompasses Sargassum critical habitat for the loggerhead sea turtle. The project area does not encompass critical habitat for any other species mentioned in **Table 4-1** above. Descriptions of the species that could potentially be impacted by the SWC TSP are described below.

Piping Plover (*Charadrius melodus*)
On December 11, 1985, the USFWS published the final rule (50 CFR 50720) that listed the piping plover as endangered in the Great Lakes watershed (Illinois, Indiana, Michigan, northeastern Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario, Canada) and as threatened elsewhere within its range. This listing includes piping plovers breeding in Canada, with their status under the Endangered Species Act (ESA) of 1973 determined by whether they breed in the watershed of the Great Lakes (endangered) or elsewhere (threatened). Piping plovers on migratory routes outside of the Great Lakes watershed or on their wintering grounds are considered threatened (USFWS 2001a).

The International Piping Plover Coordination Group facilitates the International Piping Plover Census (IPPC) of breeding and wintering piping plovers throughout their range (Elliott-Smith et al 2006). The IPPC has taken place in 1991, 1996, 2001, 2006, and 2011. (Results from 2011 have not yet been published.) (B. Firmin 2014 personal communication) Survey results for Louisiana have varied in intensity and number of sites visited over the years due to poor weather conditions, lack of personnel, and logistical constraints for site access (USFWS 2011). Results of those IPPC surveys for Louisiana range from a high of 750 birds in 1991 to a low of 226 birds in 2006; those numbers, however, do not reflect the variations in survey intensity or the number of sites visited (USFWS 2011).

In Louisiana, the 2006 IPPC recorded only 226 piping plovers, the lowest numbers in the State in IPPC history. The substantial decline in numbers of wintering piping plover along the Louisiana coast could be attributed to habitat loss as a result of Hurricanes Katrina and Rita; however, lack of personnel and poor weather conditions also affected survey intensity in the State that year (B. Firmin, USFWS, personal communication 2014). Approximately 40 piping plovers were reported in Cameron Parish in the 2006 Census.

Piping plovers arrive on wintering grounds in July, with some late-nesting birds arriving in September. Migration is poorly understood, but most piping plovers probably migrate non-stop from interior breeding areas to wintering grounds (Haig 1992). The habitats used by wintering birds include beaches, mud flats, sand flats, algal flats, and washover passes (areas where breaks in the sand dunes result in an inlet). Wintering plovers are dependent on a mosaic of habitat patches, and move among these patches depending on local weather and tidal conditions (USFWS 2001a). In late February, piping plovers begin leaving the wintering grounds to migrate back to breeding sites. Northward migration peaks in late March, and by late May most birds have left the wintering grounds (USFWS 2001a).

On July 10, 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana (piping plover critical habitat within the project area is shown in **Figure 4-1**), and Texas as critical habitat for the wintering population of the piping plover. This includes approximately 1,798.3 miles of mapped shoreline and approximately 165,211 acres of mapped area along the gulf and Atlantic coasts and along margins of interior bays, inlets, and lagoons. Approximately 6,548 acres of the aforementioned are located within Cameron and Vermilion Parishes (LA-1 Figure 4-1) (66 FR 36074). All piping plovers are considered threatened species under the Act when on their wintering grounds.

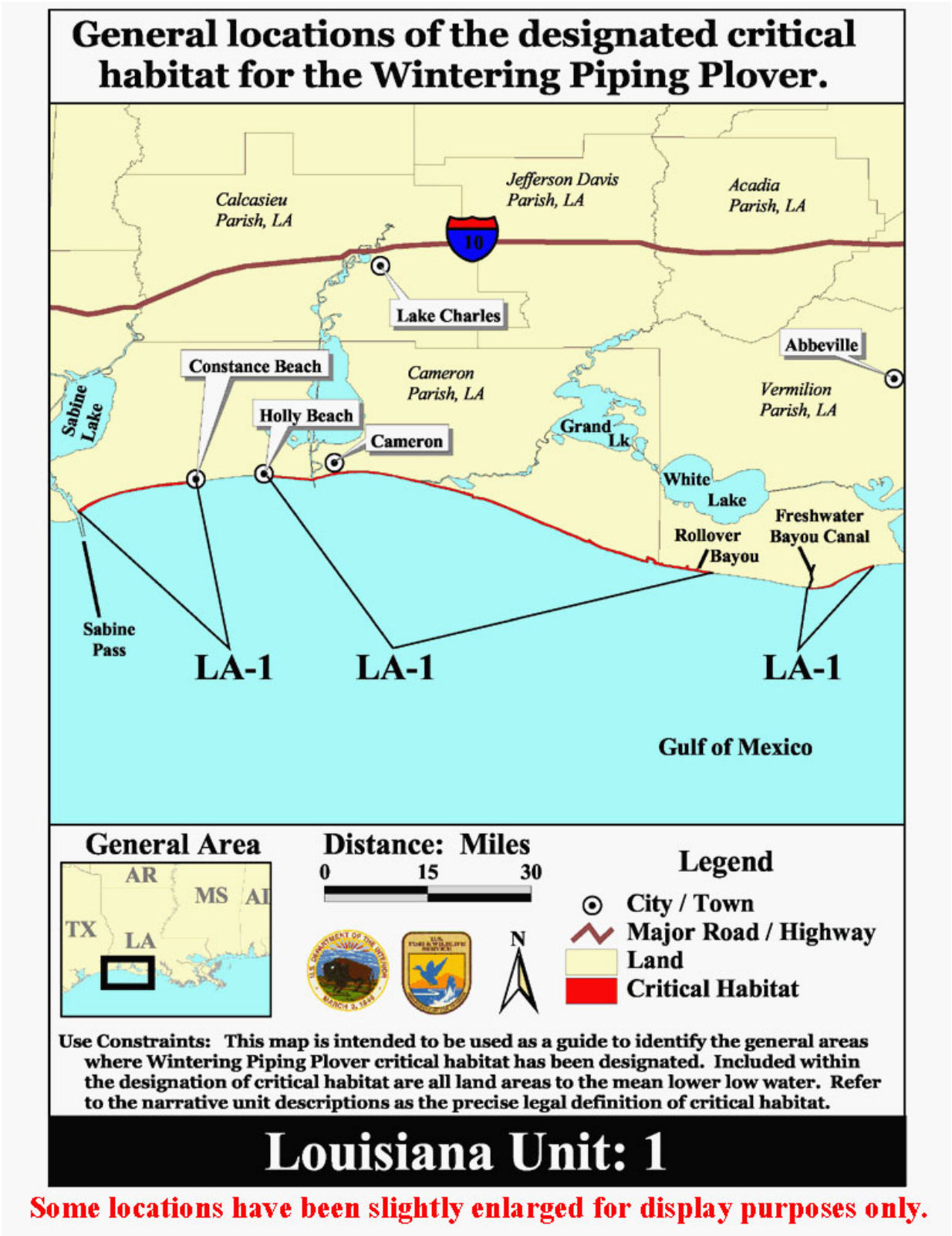


Figure 4-1 Piping plover critical habitat in the project area

Rufa red knot (*Calidris canutus rufa*)

In a 11 December 2014 final rule, the USFWS made a final determination to protect the rufa subspecies of the red knot as threatened under the ESA, with an effective date of 12 January 2015. All of the following information regarding red knot is summarized from the Rufa Red Knot Ecology and Abundance (USFWS 2014a) and final rule 50 CFR Part 17 (USFWS 2014b) and is in reference to the rufa red knot, unless otherwise stated.

The rufa red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast U.S., the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the northbound (spring) and southbound (fall) migrations, rufa red knots use key staging and stopover areas to rest and feed (USFWS 2014a, 2014b).

Louisiana is a migration stopover for red knots in both spring and fall, and some birds may overwinter in small numbers. In the U.S., the rufa red knot is found principally in intertidal marine habitats, especially near coastal inlets, estuaries, and bays, or along resting formations (i.e., intertidal shelf typically formed of densely-packed dirt blown by strong, offshore winds). Within the U.S., rufa red knot migratory and wintering habitats are principally utilized for resting and foraging activities. In the Southeastern U.S., rufa red knots commonly forage on bivalves, gastropods, and crustaceans along sandy beaches, tidal mudflats, salt marshes, and peat banks (USFWS 2014b).

Sprague's Pipet (*Anthus spragueii)*
The Sprague's pipit, is a candidate species for federal listing as a threatened or endangered species. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. The Sprague's pipit is known to or believed to occur in all parishes within the project area.

West Indian Manatee (*Trichechus manatus*)
The West Indian manatee was listed as endangered throughout its range for both the Florida and Antillean subspecies in 1967, and received Federal protection with the passage of the ESA in 1973. Critical habitat was designated in 1976, 1994, 1998, 2002, and 2003 for the Florida subspecies. This species is also protected as a depleted stock under the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407).

Manatees inhabit both salt and freshwater of sufficient depth (5 feet [1.5 meters] to usually less than 20 feet [6.1 meters]) throughout their range. Shallow grassbeds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats (USFWS 2001b). They may also be encountered in canals, rivers, estuarine habitats, saltwater bays, and have been observed as much as 3.7 miles (6.0 kilometers) off the Florida gulf coast. Between October and April, Florida manatees concentrate in areas of warmer water. During warmer months they appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water (USFWS 2001b). During summer months, they migrate as far north as coastal Virginia on the east coast and the Louisiana coast in the Gulf of Mexico (O'Shea 1988).

Sightings of the West Indian manatee in Louisiana have occurred in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, Mississippi River Gulf Outlet (MRGO), and in canals within the adjacent coastal marshes of Louisiana. However, there is no known population thriving in the state. On 9 July 2001, a manatee was observed passing safely through the Inner Harbor Navigation Canal (IHNC) Lock and into the Mississippi River, and one was sighted in Contraband Bayou in Calcasieu Parish in February, 2010.

Gulf Sturgeon (*Acipenser oxyrinchus*)
On September 30, 1991, the Gulf sturgeon was listed as a threatened species under the Endangered Species Act (ESA) (56 FR 49653).

Gulf sturgeon sightings are rare in the proposed project area; however, the LDWF (1979) reported that an Atlantic sturgeon was caught by a Mr. Hugh Mhire in an otter trawl while shrimping in the Gulf of Mexico

off the mouth of the Mermentau River, Cameron Parish, LA. This specimen was probably a Gulf sturgeon (Paruka, 2000). In 1990 a commercial fisherman reported trawling up a Gulf sturgeon three miles out from Last Island (Raccoon Island), Terrebonne Parish, LA (D. Walther, personal communication). The Gulf sturgeon is known to or believed to occur in Cameron and Vermilion Parishes within the project area.

Green Sea Turtle (*Chelonia mydas*)
The green sea turtle was listed as endangered/threatened on July 28, 1978. The breeding populations off Florida and the Pacific coast of Mexico are listed as endangered while all others are threatened (USFWS 1991). This species' current status is listed as threatened in Louisiana.

Although green sea turtles are found worldwide in oceans and gulfs with water temperatures greater than 68°F (20°C), their distribution can be correlated to grassbed distribution, location of nesting beaches, and associated ocean currents (Hirth 1971). Long migrations are often made between feeding and nesting grounds (Carr and Hirth 1962). Within Louisiana waters, these turtles probably occur all along the coast and may nest on the Chandeleur Islands (Dundee and Rossman 1989). Green sea turtles feed in shallow water areas with abundant seagrasses or algae. The turtles migrate from nesting areas to feeding grounds, which are sometimes several thousand miles away. Most turtles migrate along the coasts, but some populations are known to migrate across the ocean from nesting area to feeding grounds. The major nesting beaches are always found in places where the seawater temperature is greater than 77°F (25°C) (NMFS 1991).

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)
On 2 December 1970 the Kemp's ridley sea turtle was designated as endangered across its entire range (USFWS 1991) and has continued to decline in Louisiana (USFWS 1990). This species is currently listed as endangered in Louisiana. Critical habitat has been proposed for this species, but it has not been finalized to date.

This small sea turtle is believed to be the most frequently encountered (Dundee and Rossman 1989), if not the most abundant sea turtle, off the Louisiana coast (Viosca 1961). Kemp's ridley sea turtles have been found along coastal Louisiana from Lake Borgne, Barataria and Terrebonne Bays, and near Calcasieu Pass (Dundee and Rossman 1989). Adult Kemp's ridley sea turtles are usually confined to the Gulf of Mexico. Post-pelagic stages are commonly found over crab-rich, sandy, or muddy bottoms. Juveniles can be found in bays, coastal lagoons, and river mouths. In Louisiana, adults are found seasonally near the Mississippi river outlet. The main nesting grounds for the Kemp's ridley turtle occur on the northeastern coast of Mexico. Occurrence of these sea turtles in bays and estuaries along the Louisiana coast would not be unexpected, as many of their primary food items occur there.

Leatherback Sea Turtle (*Dermochelys coriacea*)
The leatherback sea turtle was listed as an endangered species throughout its range in June 1970 (USFWS 199l), and it is currently listed as endangered in Louisiana. Critical habitat has been established for shoreline and adjacent waters of the U.S. Virgin Islands (50 CFR 17.95; 50 CFR 226.207).

The leatherback sea turtle occurs mostly in continental shelf waters, but will occasionally enter shallow waters and estuaries. Adults are highly migratory, and are believed to be the most pelagic of all sea turtles. Habitat requirements for juvenile and post-hatchling leatherbacks are unknown (NMFS and USFWS 1992b). In Louisiana, leatherbacks are believed to occur offshore in deep waters; however, they have been sighted in Cameron Parish, Atchafalaya Bay, Timbalier Bay, and Chandeleur Sound (Dundee and Rossman 1989). No nesting has been reported in Louisiana (Gunter 1981, Dundee and Rossman 1989).

Loggerhead Sea Turtle (*Caretta caretta*)
The loggerhead sea turtle was listed as a threatened species in July 1978 (USFWS 1991), and it is currently listed as threatened in Louisiana. Critical habitat was established for this species in July 2014 within the Atlantic Ocean and the Gulf of Mexico (50 CFR 226; 79 FR 39855-39912) and within the terrestrial environment of the U.S. Atlantic and Gulf of Mexico coasts (50 CFR 17; 79 FR 39755-39854). These critical

habitat areas contain one or a combination of habitat types: nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat.

Loggerheads are capable of living in a variety of environments, such as in brackish waters of coastal lagoons and river mouths. The major nesting beaches are located in the southeastern U.S., primarily along the Atlantic coast of Florida, North Carolina, South Carolina, and Georgia. Only minor and solitary nesting has been recorded along the coasts of the Gulf of Mexico (NMFS AND USFWS 2008).

Loggerheads probably range all along the Louisiana coast; however, Dundee and Rossman (1989) reported specimens only from Chandeleur Sound, Barataria Bay, and Cameron Parish. Nesting on the gulf coast occurs between the months of April and August, with 90 percent of the nesting effort occurring on the south-central gulf coast of Florida (Hildebrand 1981). Although loggerheads have been documented as nesting on the Chandeleurs in 1962 and Grand Isle in the 1930s, it is doubtful whether this species currently successfully nests on the Louisiana coast (Hildebrand 1981, Dundee and Rossman 1989). Loggerhead Critical Habitat (*Sargassum* habitat) exists in the southern (offshore) portion of the SWC project area (see **Figure 4-2** below). This critical habitat expands the entire length of the project (west to east) and the closest points range from approximately 4 miles to 9 miles offshore.

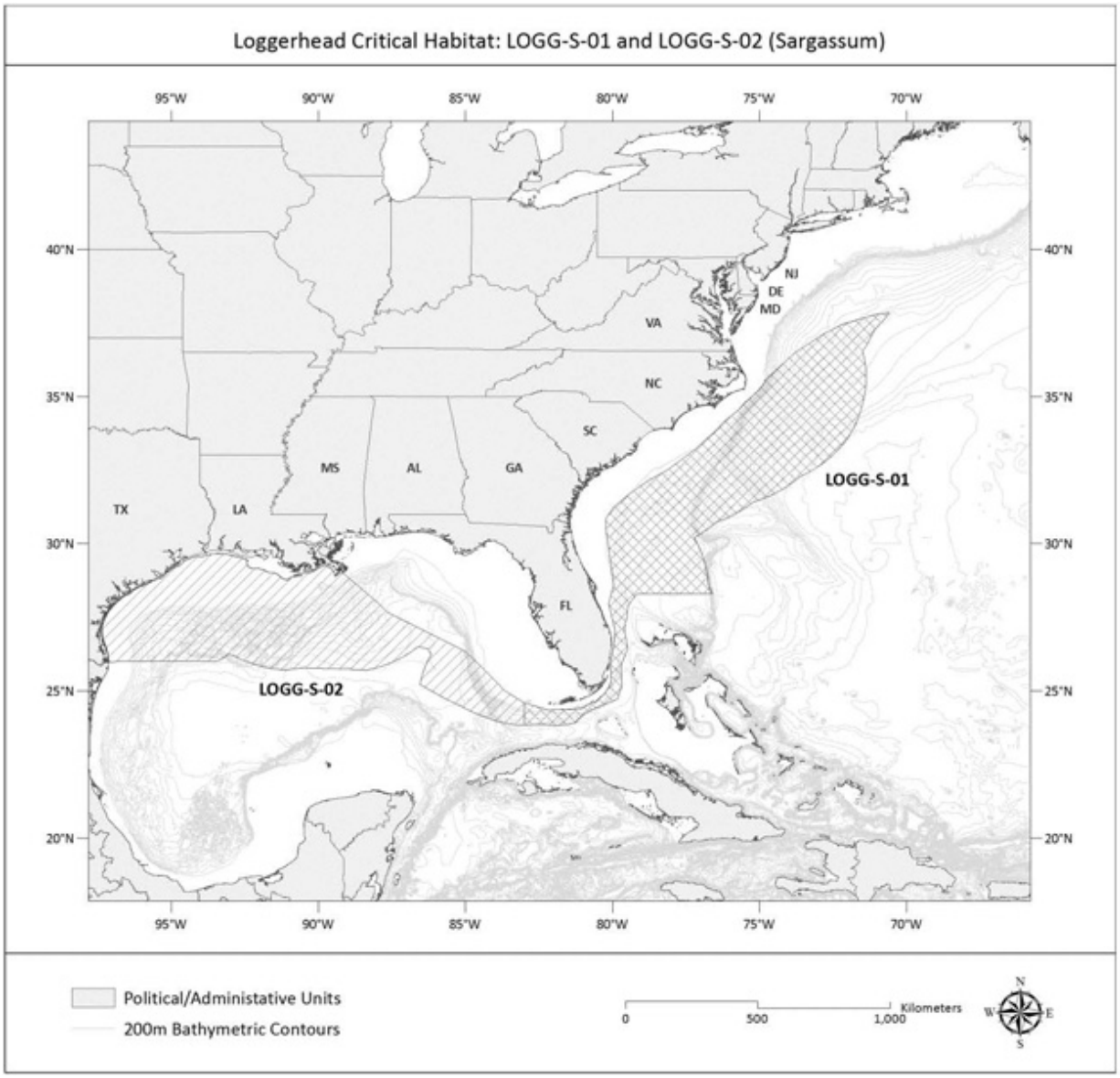


Figure 4-2 Loggerhead Sea Turtle critical habitat in the project area

Hawksbill Sea Turtle (*Eretmochelys imbricata*)
The hawksbill was listed as an endangered species in June 1970 (USFWS 1991), and it is currently listed as endangered in Louisiana.

The hawksbill occurs in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. Only one record of a hawksbill in Louisiana has been reported (Fuller and Tappen 1986). Florida is considered foraging habitat for those turtles, and Texas may be foraging habitat for hatchlings and juveniles (77 observations of small turtles were reported between 1972 and 1984) from the nesting sites in Mexico (NMFS AND USFWS 1993). Hawksbills are observed in Florida with some regularity on the reefs off Palm Beach County and in the Florida Keys. Texas is the only other state where hawksbills are sighted with any regularity. Most sightings involve post hatchlings and juveniles, which are believed to originate from nesting beaches in Mexico (NMFS AND USFWS 1993).

V. EFFECTS ANALYSIS

The potential exists that any of the endangered or threatened species listed in the previous section may be present in the project area during proposed construction activities. However, while individuals may be affected by the proposed construction activities, whole populations would not be adversely affected by implementation of the TSP. The implementation of TSP features (i.e., marsh restoration, shoreline protection, chenier reforestation, and hydraulic and salinity control features) could impact the piping plover, rufa red knot, Sprague's pipit, West Indian Manatee, Gulf sturgeon and sea turtles.

Piping Plover (*Charadrius melodus*)

The TSP would involve activities in the critical habitat of the piping plover. However, the activities are temporary and minimal (temporary placement of pipeline on the surface) and therefore it is the USACE's determination that the proposed TSP would constitute a *"may affect, but will not likely adversely affect"* determination for the species and its critical habitat. Potential project-induced impacts may result from incidental interaction with the piping plover during the following construction activities: marsh restoration features 47a1, 47a2, and 47c1 would temporarily utilize Gulf of Mexico shoreline for the placement of pipeline to deliver offshore sediment to the onshore marsh restoration areas. Approximately 0.14 acres (200 feet long by 30 feet wide) of critical habitat is expected to be impacted temporarily by these three measures. Another feature that would also temporarily utilize Gulf of Mexico shoreline for temporary pipeline placement is 124c, approximately 0.34 acres (500 feet long by 30 feet wide) of critical habitat is expected to be impacted. Due to their mobility, piping plovers would be able to avoid the aforementioned small areas of temporary disturbance by using abundant adjacent areas for foraging and roosting. Additionally, there is a considerable amount of critical habitat area within the SWC project area that could be utilized (see **Figure 4-1**).

All harmful activities (e.g., pipeline crossings) could be temporarily suspended until the bird(s) moves out of the project area. Any disturbance to the piping plover would be temporary during construction activities, and would result in temporary displacement. The piping plover would likely move and relocate to other nearby areas for foraging or roosting purposes.

Construction of the TSP is anticipated to begin in 2025, and would last up to ten years. During construction of the TSP, construction activities would include placement of hydraulically-dredged material for marsh restoration features. A marsh buggy would be used to place the pipeline across the beach. The noise and disturbance during construction activities would cause the displacement of wildlife in the construction area and nearby vicinity.

Rufa red knot (*Calidris canutus rufa*)

The TSP would involve activities in suitable habitat of the rufa red knot. However, the activities would be temporary and minimal and therefore it is the USACE's determination that the proposed TSP would constitute a *"may affect, but will not likely adversely affect"* determination for the species. Potential project-induced impacts may result from incidental interaction with the rufa red knot during the following construction activities: marsh restoration features 47a1, 47a2, and 47c1 would temporarily utilize Gulf of Mexico shoreline for the placement of pipeline to deliver offshore sediment to the onshore marsh restoration areas. Approximately 0.14 acres (200 feet long by 30 feet wide) of shoreline habitat is expected to be impacted temporarily by these three measures. Other features that would also temporarily utilize Gulf of Mexico shoreline for temporary pipeline placement are: 124c, approximately 0.34 acres of suitable habitat is expected to be impacted; 306a1 and 127c3, approximately 1.10 acres of suitable habitat is expected to be impacted. Due to their mobility, rufa red knots would be able to avoid the aforementioned small areas of temporary disturbance by using abundant adjacent areas for foraging and roosting. Additionally, there is a considerable amount of habitat within the SWC project area that could be utilized (see **Figure 4-1**).

Because the piping plover and rufa red knot share similar foraging/roosting behaviors and utilize similar coastal habitats within Louisiana, the effects of the action are also very similar for both species. Therefore, see the discussion for impacts to piping plover.

Sprague's Pipit (*Anthus spragueii)*
The USACE has determined that the proposed TSP would constitute a *"may affect, but will not likely adversely affect"* determination for candidate species, Sprague's pipit. Depending on final designs of the NED TSP, potential indirect and minimal impacts could occur to the species. These impacts would include the temporary displacement of any birds that may be present due to construction activity and noise. The NER TSP could cause minimal indirect impacts to the species, if present, in the event that chenier reforestation occurs on grasslands. It is assumed that the birds would relocate to adjacent or nearby suitable foraging/roosting areas.

West Indian Manatee (*Trichechus manatus*)
Should any manatees be encountered during the proposed activities, an on-board observer would notify the proper personnel, and harmful activities (e.g., dredging) would be temporarily suspended until the animal(s) moves out of the project area. Any disturbance to the manatee would only be temporary during construction activities, and would result in temporary displacement. The manatees would likely move and relocate to other nearby areas for foraging or resting purposes.

Because the West Indian manatee may occur in the project area, the Contractor shall instruct all personnel associated with the project of the potential presence of manatees in the area, and the need to avoid collisions with these animals. All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the MMPA of 1972 and the ESA of 1973. The Contractor shall be held responsible for any manatee harmed, harassed, or killed as a result of construction activities not conducted in accordance with these specifications. See **Annex B** for special operating conditions if manatees are present in the project area.

Gulf Sturgeon
Due to the rarity of the Gulf sturgeon within the project area, MVN concludes that the proposed action *"may affect, but will not likely adversely affect"* the Gulf sturgeon. However, all contract personnel associated with the project would be informed of the potential presence of Gulf sturgeon and best management practices (**Annex B**) would be implemented to avoid impacts to the listed species.

Sea Turtles
It is anticipated that the contractor will utilize a hydraulic cutterhead dredge and booster pump(s) to excavate sediment from available offshore borrow area(s) and then transport it through a submerged sediment pipeline to the marsh restoration areas. Hopper dredges are not being proposed. Incidental takes of sea turtles have only been documented from hopper dredge operations that use trailing suction dragheads. Thus far, no incidental takes of sea turtles have been reported from clamshell (mechanical dredge), pipeline cutterhead (hydraulic dredge), or other types of dredges operating in southeastern coastal channels. Operational differences between these dredge types contribute to the differences in potential impacts to sea turtles. The relatively slow dredging motion of clamshell and pipeline dredges present minimal risk for sea turtle takes (Diskerson et al. 2004). Environmental laws protecting sea turtles could require the cessation of work for a limited time if the allowable number of sea turtle mortalities is exceeded during dredging. Additionally, sediment used to construct the containment dikes will be dredged from existing material inside the marsh creation area rather than from offshore borrow areas and therefore dredging operations associated with containment dikes are not expected to adversely impact sea turtles.

By implementing the above-mentioned monitoring and avoidance program, it is the USACE's determination that the proposed TSP plan *"may affect, but will not likely adversely affect"* some sea turtles and have *"no effect"* on others.

Green Sea Turtle (*Chelonia mydas*)
Due to the lack of extensive seagrass beds in and near the project area, the lack of major nesting colonies along coastal Louisiana, and the low incidence of sightings and strandings along coastal Louisiana (NMFS 1991), it is the USACE's determination that the TSP is expected to have *"no effect"* on the green sea turtle population.

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)
The proposed wetland restoration/nourishment and shoreline protection features would provide a more suitable inshore foraging habitat (i.e., characterized by low salinity, high turbidity, and high organic content – where shrimp and blue crabs are abundant) for this species (NMFS and USFWS 1992a). Given the Kemp's ridley sea turtle has been found along Louisiana's coast, it is possible that the dredging of borrow material for the marsh creation features would have an effect; however, the Kemp's ridley sea turtle would likely avoid the borrow areas during construction. It is the USACE's determination that the proposed TSP plan *"may affect, but will not likely adversely affect"* the Kemp's Ridley sea turtle population.

Leatherback Sea Turtle (*Dermochelys coriacea*)
Leatherback sea turtles occur mostly in continental shelf waters more than 164 feet (50 meters) in depth and are uncommon in shallow Gulf of Mexico waters along Louisiana. There are no known nesting records for this species reported for Louisiana (NMFS and USFWS 1992b). Therefore, it is the USACE's determination that the TSP is expected to have *"no effect"* on the leatherback sea turtle population.

Loggerhead Sea Turtle (*Caretta caretta*)
The project area does not contain suitable nesting habitat and no suitable habitat will be created by the TSP. Loggerhead sea turtle Critical Habitat (*Sargassum* habitat) exists in the southern (offshore) portion of the SWC project area (see Figure 4-2). The closest proximity the critical habitat comes to the shoreline is approximately 4 miles. Given the location of the loggerhead sea turtle's Critical Habitat (*Sargassum* habitat), and the fact that dredging activities would be limited to approximately 3 miles offshore avoiding impacts to critical habitat, it is the USACE's determination that the proposed TSP would have "no effect" on loggerhead critical habitat. The loggerhead sea turtle would likely avoid the borrow areas during construction minimizing the potential of impacts to the species. It is the USACE's determination that the proposed TSP plan *"may affect, but will not likely adversely affect"* the loggerhead sea turtle population.

Hawksbill Sea Turtle (*Eretmochelys imbricata*)
Due to its rarity along the Louisiana coast and its preference for nesting on beaches in Puerto Rico and the U.S. Virgin Islands (NMFS AND USFWS 1993), it is the USACE's determination that the TSP is expected to have *"no effect"* on the hawksbill sea turtle population.

Effects on Other Species of Concern
MVN has assessed the environmental impacts of the proposed action on species found in the project area that are protected under the MMPA of 1972, the MBTA of 1918, and the Migratory Bird Conservation Act of 1929.

MVN has determined that, with use of guidelines from USFWS and nesting bird abatement plan (if necessary), the proposed action would have no adverse impacts on protected birds (see **Section IV** for discussions on colonial nesting birds and shore birds).

MVN has determined that, with use of the best management practices (**Annex B**) established in coordination with NMFS, the proposed action would have no adverse impacts on bottlenose dolphins (see **Section IV** for discussions on bottlenose dolphins).

VI. CONCLUSION AND DETERMINATION OF EFFECTS

Based on the above information, the MVN has determined that the proposed action *"may affect but will not likely adversely affect"* the piping plover or it's critical habitat, red knot, West Indian manatee, Gulf sturgeon,

loggerhead and Kemps Ridley sea turtles; would have no effect on the green, leatherback, and hawksbill sea turtles or loggerhead critical habitat and would not adversely impact other species of concern that could potentially be found in the project area. MVN requests your concurrence on the aforementioned determinations.

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SOUTHWEST COASTAL LOUISIANA
REVISED INTEGRATED DRAFT FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Annex L

Adaptive Management and Monitoring Plan

1. **INTRODUCTION**

INTRODUCTION TO ADAPTIVE MANAGEMENT AND MONITORING

1.1 ADAPTIVE MANAGEMENT AND MONITORING PROCESS

1.2 AUTHORIZATION AND IMPLEMENTATION GUIDANCE

1.3 ADAPTIVE MANAGEMENT AND MONITORING PROGRAM STRUCTURE

1.4 COMMUNICATION STRUCTURE FOR IMPLEMENTATION OF ADAPTIVE MANAGEMENT

2. ADAPTIVE MANAGEMENT AND MONITORING PLANNING

2.1 CONCEPTUAL ECOLOGICAL MODEL FOR MONITORING AND ADAPTIVE MANAGEMENT

2.2 PROJECT GOALS, OBJECTIVES AND CONSTRAINTS

2.3 MANAGEMENT AND RESTORATION ACTIONS —TENTATIVELY SELECTED PLAN

2.4 SOURCES OF UNCERTAINTY AND ASSOCIATED RISKS

2.5 RATIONALE FOR ADAPTIVE MANAGEMENT/ UNCERTAINTY AND RISK MANAGEMENT

3. MONITORING

3.1 MONITORING PLAN ELEMENTS

4. ASSESSMENT

4.1 ASSESSMENT PROCESS

4.2 DOCUMENTATION AND REPORTING

5. DATA MANAGEMENT

6. ADAPTIVE MANAGEMENT AND DECISION MAKING PROCESSES

7. LESSONS LEARNED

8. COSTS FOR IMPLEMENTATION OF ADAPTIVE MANAGEMENT AND MONITORING

9. **REFERENCES**

INTRODUCTION

Wetland loss in Southwest Louisiana experienced approximately 20 percent of the total wetland loss observed in Louisiana from 1932-2010 (Couvillion et al., 2011). The processes of sea level rise, ground subsidence, saltwater intrusion, and erosion of wetlands have caused significant adverse impacts to the study area (Figure 1). The continued land loss and ecosystem degradation threaten the productivity of the Southwest's ecosystems, the economic viability of its industries, and the safety of its residents. Without action, this highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. The goal of the Southwest Coastal Louisiana Feasibility Study is to develop a comprehensive plan for Southwest Louisiana for that will provide hurricane and storm damage risk reduction and provide coastal restoration measures to achieve ecosystem sustainability.

Initially, two separate studies were underway in the Southwest Coastal project area—one for coastal restoration under the LCA program and one for hurricane risk reduction following the impacts of Hurricane Rita in 2005. Recognizing the importance of coastal restoration for hurricane risk reduction and to reduce redundancies, the two projects were integrated. The Southwest Coastal project will produce both a National Economic Development (NED) plan for hurricane risk reduction and a National Ecosystem Restoration (NER) plan for ecosystem restoration. Please refer to Chapter 1 Section 7 of the Final Integrated Feasibility Report and PEIS for additional information on the authorities for the Southwest Coastal Study.

Since the restoration in the Southwest Coastal area is a large-scale project that may influence regional conditions, an Adaptive Management and Monitoring (AM&M) Program will be implemented before, during, and after construction. Such monitoring will allow the USACE to assess the progress of restoration and will provide the necessary information to adjust project performance through adaptive management (AM), if necessary, to better meet project goals and objectives, and will ultimately provide information to better design and maintain coastal resources in the future.

In accordance with the Water Resources Development Act of 2007 Section 2036, Section 2039 and subsequent implementation guidance (CECW-PB Memorandum dated August 31, 2009), AM&M are required for both National Ecosystem Restoration (NER) project components and for any Mitigation Plan required forthe National Economic Development (NED) component. This AM&M Plan describes the monitoring design proposed to evaluate NER project progress towards meeting the restoration objectives, describes the organizational structure for the AM&M process, identifies key uncertainties, and describes potential AM actions. A separate plan is not needed for the NED since mitigation is not currently anticipated to be required.

Many factors such as ecosystem dynamics, engineering applications, institutional requirements, and many other key uncertainties can change and/or evolve over a project's life. The AM&M Plan will be regularly updated to reflect monitoring-acquired and other new information as well as resolution of and progress on resolving existing key uncertainties or identification of as any new uncertainties that might emerge. Specifically, this AM&M Plan will be revised and updated and project measure specific plans developed during the feasibility level of design phase and further in the pre-construction engineering and design (PED) phase as more detailed project designs are developed and uncertainties are better understood. The AM&M plan will then be used during and after project construction to adjust the project, as necessary, to better achieve goals, objectives, and restoration/management outputs/results.

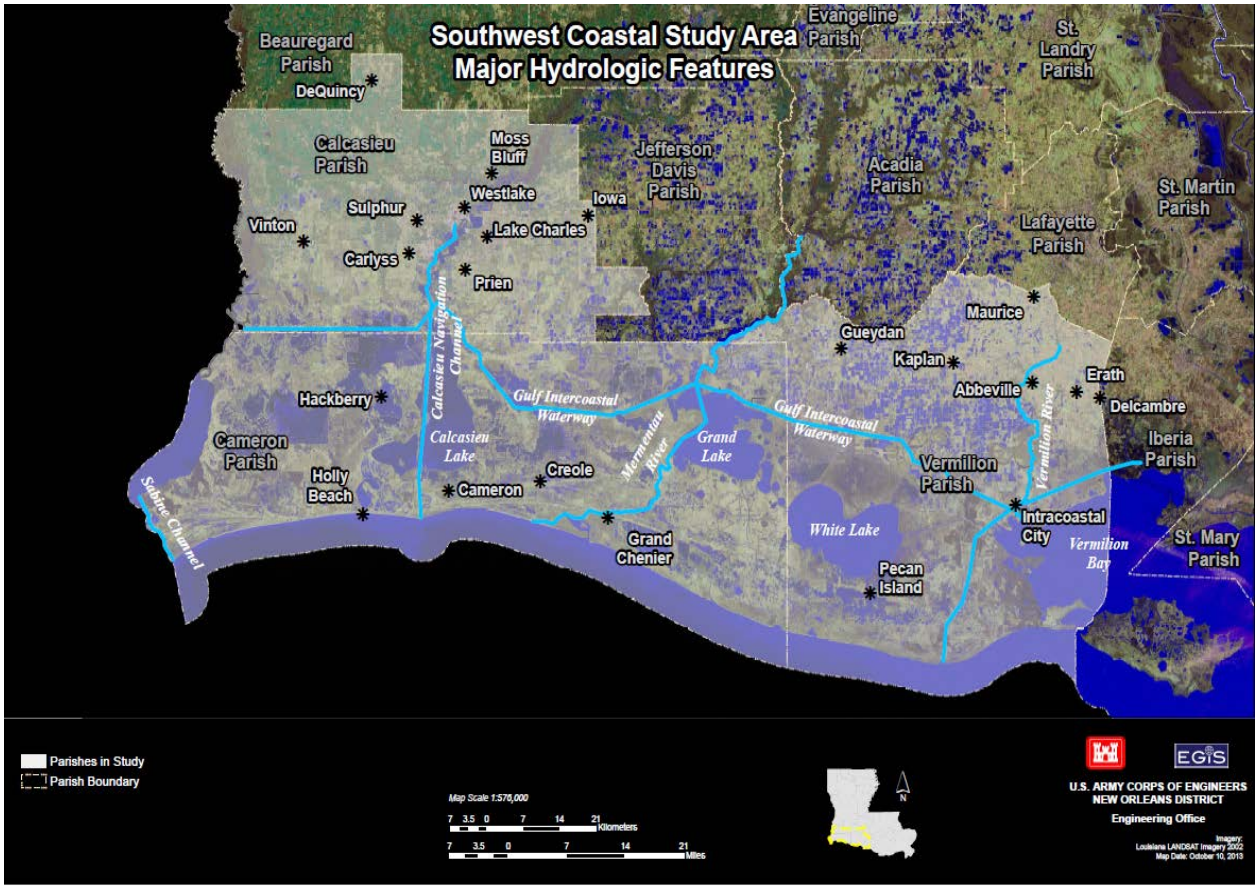

Figure 1: Southwest Coastal Louisiana study area.

Introduction to Adaptive Management and Monitoring

Adaptive Management and Monitoring (AM&M) provides a directed iterative approach to achieving restoration project goals and objectives by focusing on strategies promoting flexible decision making that can be adjusted in the face of uncertainties as outcomes from restoration management actions and other events become better understood. Initiating a formal AM&M process early in the study process enables the Project Delivery Team (PDT) to identify and resolve key uncertainties and other potential issues that can positively or negatively influence project outcomes during every stage of the planning and project implementation process. Hence, early implementation of AM and monitoring will result in a project that can better succeed under a wide range of uncertain conditions and can be adjusted as necessary. Furthermore, careful monitoring of project outcomes both advances scientific understanding and helps adjust policies and/or operations as part of an iterative learning process (National Research Council 2004).

Learning from the management experience is certainly not a new idea; but the purposeful and systematic pursuit of knowledge to address identified uncertainties has rarely been practiced. Adaptive management acknowledges the uncertainty about how ecological systems function and how they may respond to management actions. Nevertheless, AM is not a random trial-and-error process; it is not ad-hoc or simply reactionary. An essential element of AM is the development and execution of a monitoring and assessment program to analyze and understand responses of the system to implementation of the project as restoration progresses. The AM&M Program for the Southwest Coastal Project Ecosystem Restoration/NER components was developed and will be used to:

- Allow scientists and managers to collaboratively design plans for managing complex and incompletely understood ecological systems
- Reduce uncertainty over time
    - Acknowledgement, identification, and characterization of risks and uncertainties

    - Uncertainty can be analyzed and exploited to identify key gaps in information and understanding
- Implement systematic monitoring of outcomes and impacts
    - Scientific information obtained through continued monitoring is used to evaluate and manage uncertainties to achieve desired goals and objectives
    - Explicitly stated goals and measurable indicators of progress toward those goals
    - Demonstrate to others that the project is meeting or exceeding performance goals; "ecological success"
    - Detect detrimental system responses as early as possible in order to minimize the adverse effects of these responses
    - Evaluate hypotheses and performance measures and revise conceptual ecological models as appropriate
- Incorporate an iterative approach to decision-making
    - The monitoring data is used to influence future management decisions
    - Feedback loops are developed so that monitoring and assessment produce continuous and systematic learning that in turn is incorporated into subsequent decision-making
    - Projects and programs can be implemented in phases to allow for course corrections based on new information to allow for management flexibility
- Provide a basis for identifying options for improvements in the design, construction and operation of Southwest Coastal Restoration through AM
- Develop reports on the status and progress of the Southwest Coastal Restoration for the agencies involved, the public, Congress, and stakeholders
- Enhance predictive capability through improvements in simulation models before and after project construction
- Provide information to summarize and develop lessons learned to optimize restoration strategies in the future; "lessons learned"
- Ensure interagency collaboration and productive stakeholder participation as they are key elements to success. AM encourages defining agency objectives for stakeholder involvement, deciding upon a strategy for stakeholder involvement, clearly communicating this to the public, and maintaining long-term collaboration among stakeholders. Continued communication with key stakeholders helps identify and reduce socio-economic uncertainties, measure project progress towards objectives, and adaptively manage projects (Knight *et al.*, 2008, Smith *et al.*, 2009, Nkhata and Breen 2010)

1.1 Adaptive Management and Monitoring Process

The developed AM&M program and process is complimentary to the USACE Project Life Cycle (planning, design, construction and operation and maintenance). The AM&M process is not elaborate or duplicative and enhances activities that already take place. The basic process of AM&M for USACE projects (Figure 2) was adapted from the DRAFT USACE Adaptive Management Technical Guide (USACE 2011) and includes:

- **Planning** a program or project;
- **Designing** the corresponding project;
- **Building** the project (construction and implementation);
- **Operating** and maintaining the project; and
- **Monitoring** and **assessing** the project performance;
- **Continue** project implementation as originally designed; or
- **Adjust** the project if goals and objectives are not being achieved
- **Complete** project if goals and objectives and **success** criteria are achieved, or it is determined the project has **success**fully produced the desired outcomes
- Project **Termination** is possible if project goals and objectives are not being achieved and the decision is made not to adjust the project or no adjustments are possible

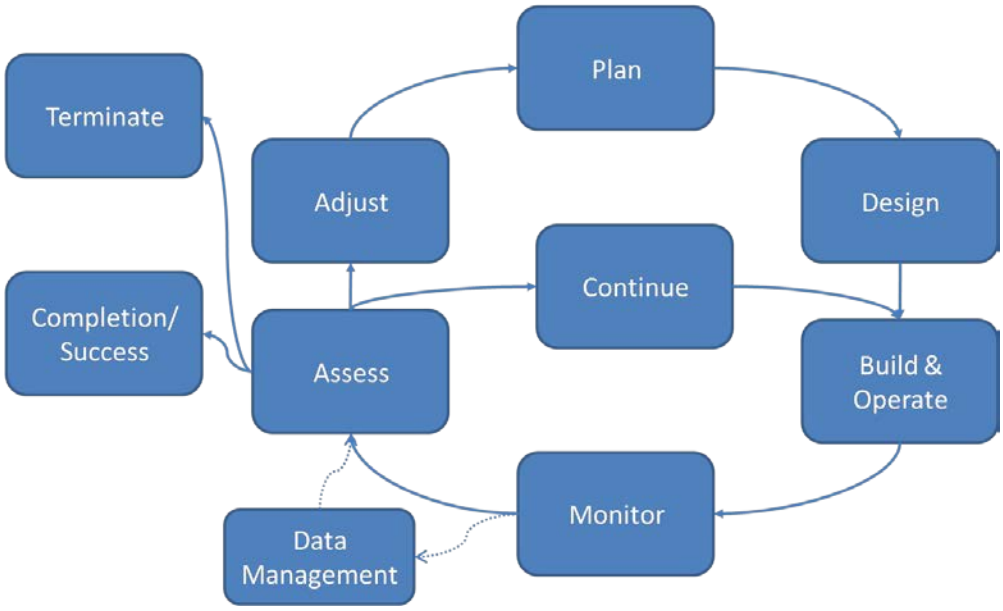

Figure 2: Adaptive management monitoring and process for the USACE Ccivil works.

1.2 Authorization and Implementation Guidance

The WRDA of 2007, Section 2039 of the Water Resources Development Act (WRDA) of 2007 and Implementation guidance for Section 2039, in the form of a CECW-PB Memo dated 31 August 2009; require ecosystem restoration projects to develop a plan for monitoring the success of the ecosystem restoration and to develop an AM Plan (contingency plan).

The Monitoring Plan

- The plan must specify nature, duration, and periodicity of monitoring, disposition of monitoring and analysis, costs, and responsibilities.
- Scope and duration should include the minimum monitoring actions necessary to evaluate success.
- Monitoring plan will be reviewed during Agency Technical Review (ATR) and Independent External Peer Review (IEPR) as necessary.
- Monitoring will be continued until "restoration success" is documented by the USACE District Engineer in consultation with federal and state resource agencies and determined by USACE Mississippi Valley Division Commander.
- Success is determined by an evaluation of predicted outcomes compared to actual results.
- Financial and implementation responsibilities for monitoring will be included in the Project Partnership Agreement (PPA).
- Cost-shared (under Construction) component not to exceed 10 years. Cost shared monitoring costs must be included as part of the project cost and cannot increase the Federal cost beyond the authorized dollar limit. Monitoring can end sooner if success is determined.
- Post Construction monitoring that may be needed beyond 10 years is a 100% non-Federal responsibility.

Adaptive Management/Contingency Plan

- Adaptive management plan must be appropriately scoped to project scale.
- The rationale and cost of AM and anticipated adjustments will be reviewed as part of the decision document.
- Identified physical modifications will be cost-shared and must be agreed upon by the sponsor.

- Changes to the AM plan approved in the decision document must be coordinated with USACE Headquarters (HQUSACE).
- Significant changes needed to achieve ecological success that can't be addressed through operational changes or the AM plan may be examined under other authorities.
- Costly AM plans may lead to re-evaluation of the project.

The importance of Adaptive Management was reinforced with the release of the Civil Works *Strategic Plan 2011-2015: Sustainable Solutions to America's Water Resources Needs* which identified Adaptive Management as a strategy to support the USACE moving towards Integrated Water Resources Management.

1.3 Adaptive Management and Monitoring Program Structure

The U.S. Army Corps of Engineers (USACE), New Orleans District (MVN), Louisiana Coastal Protection and Restoration Authority (CPRA), and the US. Geological Survey (USGS) collaborated to establish a general framework for adaptive management to be applied to all USACE Regional Planning Division South (RPDS) restoration projects. The framework for AM&M is consistent with the previously mentioned authority, implementation guidance, and is consistent with and supports the guidance provided by:

- Technical Letter: Procedures to Evaluation Sea Level Change: Impacts Responses and Adaptation (ETL 1100-2-1)
- DRAFT U.S. Army Corps of Engineers: A Systems Approach to Adaptive Management USACE Technical Guide (USACE 2011)
- U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's (NOAA) "Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process" (Federal Register vol. 65, No. 106 35242)
- Planning Guidance Notebook (Engineering Regulation [ER] 1105-2-100) (USACE 2000)
- Planning Manual (Institute for Water Resources [IWR] Report 96-R-21; (Yoe and Orth 1996), Civil Works Ecosystem Restoration Policy (ER 1165-2-501)
- Ecosystem Restoration – Supporting Policy Information (EP 1165-2-502).

Please note that a Standard Operating Procedure (SOP) providing guidance for integration of Adaptive Management and Monitoring into Ecosystem Restoration and Mitigation Projects is being developed for the USACE Regional Planning & Environmental Division, South and will be incorporated in further versions of this AM&M plan once approved.

Adaptive Management and Monitoring Framework

The AM&M Framework includes both a Set-up Phase (Figure 2) and an Implementation Phase (Figure 3). The Set-up Phase proceeds concurrently with the USACE's traditional six-step planning process. While planners are identifying problems and opportunities, inventorying and forecasting resource conditions, evaluating and comparing alternative formulations, and selecting a recommended plan, the AM&M Plan for the project will be developed concurrently. In addition to the items developed during the planning process a conceptual ecological model (CEM) will be developed, uncertainties will be identified; and performance measures, targets, and decision criteria (triggers and thresholds) will be developed. See subsequent Sections of the AM&M plan for the CEM and performance measures developed thus far.

The implementation phase of the AM&M Framework subsequently puts the developed AM&M Plan into action. Projects will be designed, constructed, monitored and assessed to understand responses of the system to implementation of the project relative to stated targets, goals, objectives and success project criteria. Leadership will then decide whether to alter the project and implement AM actions to improve plan performance based on assessment results. Potential AM actions for the project are identified in Section 6.

Baseline monitoring will begin during PED prior to project construction and continue during construction when possible. Although not typical there may be some need for AM actions during construction.

Unexpected detrimental events may alter the project site, requiring consideration of corrective measures. For example, a tropical event impacting a project site or invasion of an exotic species may necessitate management actions. A decision will be required on how to address the change in conditions. In addition, since it is expected that construction/implementation will be phased over a long period of time, there is greater potential for changing conditions due to construction methods, deviations from selected methods, or development of new information. It will need to be determined if these need to be corrected, whether they are acceptable, or whether they enhance the site. Using an AM strategy in this situation may increase the chances of overall project success. Design changes during construction may require changes to the AM&M Plan.

Post Construction, the project will enter the iterative cycle of AM where the project will be monitored. The results of the monitoring program will be used to assess system responses to management, evaluate overall project performance, and assemble Assessment Reports and project Report Cards as outlined in the AM&M Plans (Sections 5 & 6). These monitoring results and reports will guide decision making. The projects' Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) manuals should clearly communicate the AM&M Plans and process including: monitoring parameters, frequency and duration of monitoring and assessment, decision criteria, and options for adjustment to increase project success.

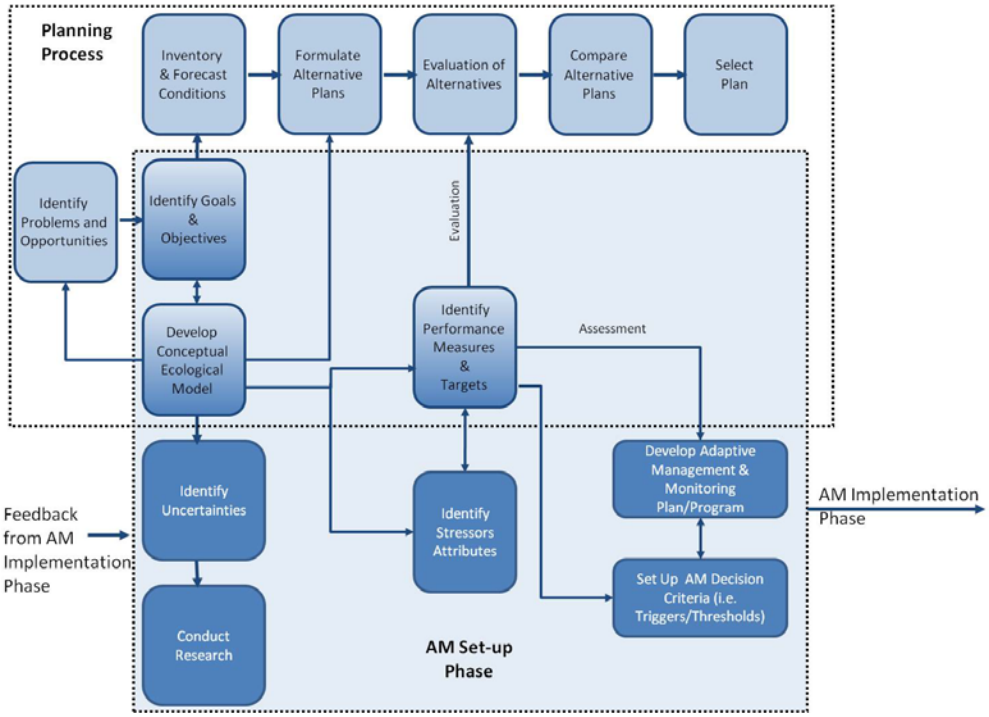

Figure 3: Set-up phase of adaptive management and monitoring program framework.

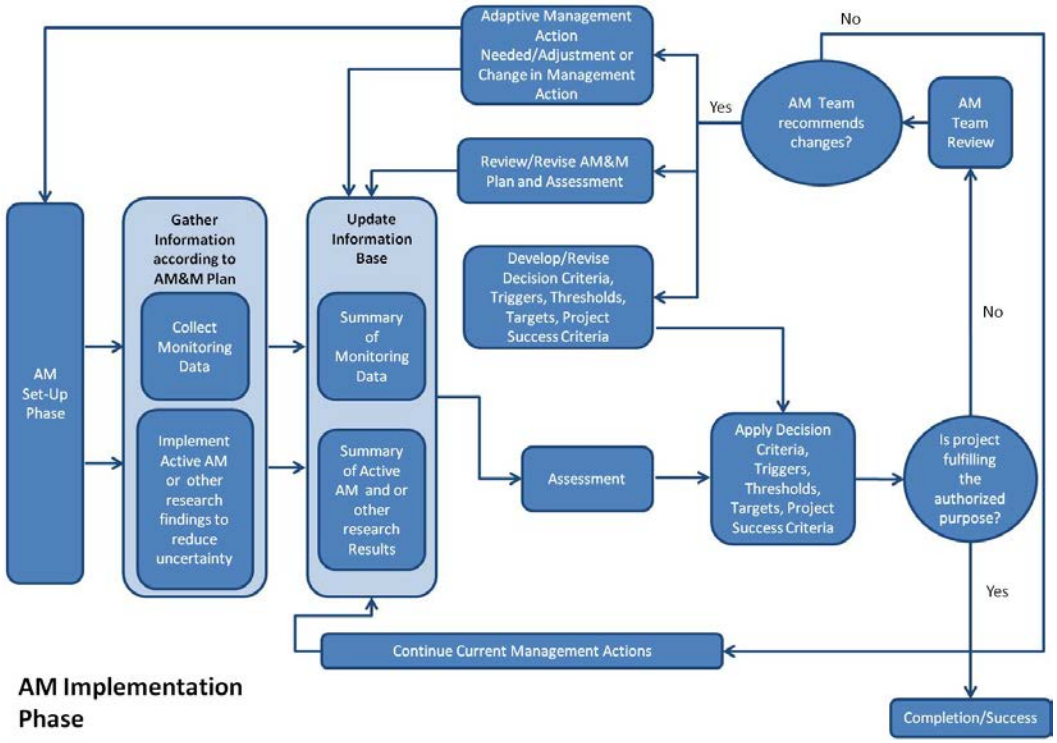

Figure 4: Implementation phase of adaptive management and monitoring program framework.

1.4 Communication Structure for Implementation of Adaptive Management

An implementation structure has been identified (Figure 4) to execute AM&M for USACE Regional Planning Division South (RPEDS) Ecosystem Restoration projects. The structure establishes lines of communication that facilitates coordination between Program Management, the PDT, the Adaptive Management and Monitoring Planning Team, the USACE Science Advisor, and stakeholders. Please note that a detailed governance structure and decision making process for RPEDS AM&M is being developed. This information once approved will be included in subsequent revisions to this AM&M plan.

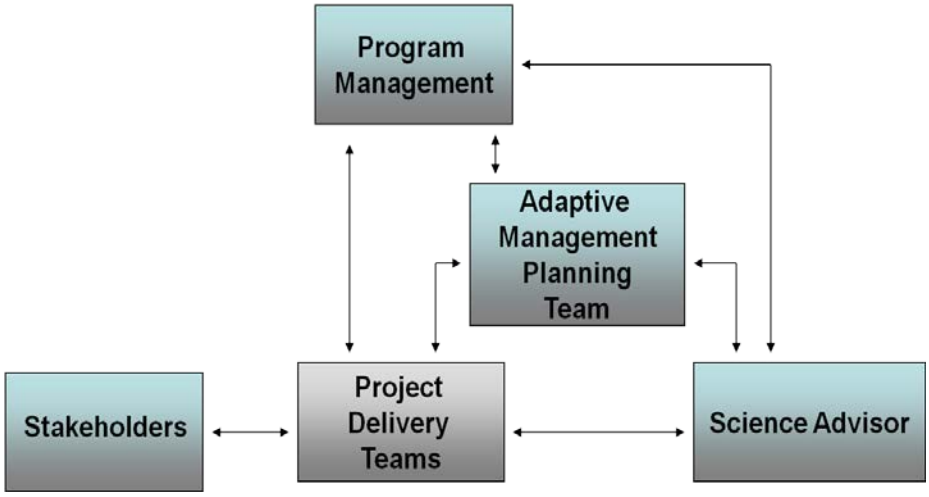

Figure 5: Communication structure for implementation of adaptive management and monitoring.

Adaptive Management and Monitoring Team- An interagency Adaptive Management and Monitoring Team (AM&M Team) will be established as part of the implementation structure (Figure 4). The AM&M Team, in collaboration with the PDT, will lead all project and program efforts to determine AM and monitoring recommendations. The AM&M Team is responsible for ensuring that monitoring data and assessments are properly used in the AM decision-making process. If the AM&M Team determines specific AM actions are needed, the AM&M Team will coordinate a path forward with the PDT, USACE Science Advisor and Program Management Team. The AM&M Team will also facilitate coordination between restoration projects and coordination among PDTs, and Program Management.

Program Management Team- The Program Management Team is composed of the Executive Director of the non-federal sponsor and the District Commander of USACE-MVN. The Program Management Team will vet program and project level issues, consider recommendations for AM actions, make final decisions on whether AM actions are required, and implement recommended final management actions.

Science Advisor- The purpose of the USACE Science Advisor will be to effectively address system-wide coastal ecosystem restoration needs and to provide a strategy, organizational structure, and process to facilitate integration of science and technology into the system-wide planning and the AM process.

Project Delivery Team- It is not necessary that the PDT, Project Managers, Plan Formulators, Environmental Planners or Engineers become AM&M experts. However, they need a general understanding of AM&M principles as they are key players in the integration of AM into planning and project development and implementation. The PDT is responsible for the development of the AM&M Plans in coordination with the AM&M Team. The PDT is also responsible for integrating Project-level AM&M activities into Project Management Plans, SMART Planning project documents, Feasibility Reports, NEPA and permit documents, Project Operating Manuals, and other project-related documentation.

To accomplish these tasks, the PDT will:

- lead the discovery of uncertainties;
- lead the engagement of stakeholders;
- consult with Program Management and the AM&M team;
- develop and execute strategies for resolving uncertainties; and
- develop, review, and update the AM&M Plan as necessary.

The PDT will likely be re-established during the project implementation phase to further refine monitoring, assessment and AM decisions; identify new uncertainties; re-evaluate and re-formulate and implement, as necessary, specific or overall project performance and management measures and features.

Stakeholders- Engagement with stakeholders throughout a project's planning and implementation phases is critical to developing and maintaining common understandings of the goals and objectives, expectations of results, and potential commitment of resources. All phases of the AM&M process must be open, transparent and accessible to stakeholders. Such interaction fosters the mutual understanding of events and appreciation of the time and patience required to fully realize the benefits of restoration projects and to manage unrealized expectations. A strong effort must be made to identify and engage all appropriate stakeholders. PDTs should continually seek to identify governmental and non-governmental organizations, groups and other interested parties who could affect, be affected by, and/or be able to contribute knowledge, data, and/or resources to project-related activities (e.g., planning, design, implementation, and monitoring).

ADAPTIVE MANAGEMENT AND MONITORING PLANNING

A small team with members from the USACE and the US Geological Survey (USGS) developed the draft AM&M plan for the project for review by the interagency PDT. The level of detail in this plan is based on currently available programmatic project data and information developed during plan formulation as part of

the feasibility study. Since the feasibility study is at the programmatic level, uncertainties remain concerning the exact project features, project implementation, monitoring elements, and adaptive management opportunities. As uncertainties are addressed in the latter stages of the feasibility study and as specific project measures are developed, the AM&M Team will be formed and a detailed AM&M plan, including detailed cost estimates, monitoring protocols, AM triggers and thresholds and AM actions will be developed.

2.1 Conceptual Ecological Model for Monitoring and Adaptive Management

As part of the AM and project planning process, a conceptual ecological model (CEM; Appendix A; Annex L; Attachment 1) was developed to help explain the general functional relationships among the essential components of the Southwest Coastal Louisiana area. The Director of Civil Works 13 August 2008 Memorandum "Policy Guidance on Certification of Ecosystem Output Models" adopted recommendations from the Ecosystem Planning Center of Expertise (ECO-PCX) regarding the importance, use and review of conceptual models in ecosystem planning.
CEMs are a means of:

(1) simplifying complex ecological relationships by organizing information and clearly depicting system components and interactions;
(2) integrating to more comprehensively implicit ecosystem dynamics;
(3) Aids in identifying which species will show ecosystem response;
(4) interpreting and tracking changes in restoration/management targets; and
(5) communicating these findings in multiple formats.

This CEM assists with identifying those aspects where the project can effect change. Specifically, the CEM identifies those major stressors, ecosystem drivers, and critical thresholds of ecological processes and attributes of the natural system likely to respond to restoration features. This project CEM was used to help identify problems, opportunities, and help refine project objectives and restoration management actions as well as selecting those attributes to be used as performance measures, modeling for alternative analysis, and monitoring for project success. The project CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available to assist with developing AM and monitoring during project planning and implementation.

Factors identified for the Southwest Coastal project area are listed below and further detailed in Appendix A, Annex L, Attachment 1.

Drivers

D1: Relative Sea Level Rise (Sea Level Rise and Subsidence)
D2: Numerous *Hurricanes and Storms*
D3: Hydrologic Alteration
D4: Sediment Supply to the Chenier Plain
D5: Mineral and Sediment Extraction

Ecological Stressors

ES1: Increased Flood Duration
ES2: Storm Surge
ES3: Saltwater/Salinity
ES4: Shoreline Erosion
ES5: Marsh fragmentation.
ES6: Increased Tidal Prism or Amplitude.
ES7: Altered Circulation

Ecological Effects

EE1 Wetland Loss
EE2 Decreased Primary Productivity

EE3 Habitat Conversion and Changes in Biological Community Composition
EE4 Loss of Ridges and Cheniers

Attributes and Performance Measures

A1 Land Cover/ Land Change
Performance Measures: Relative Change in Land Cover
A2 Vegetation Distribution and Diversity
Performance Measures: Community Composition and Relative Abundance
A3 Elevation
Performance Measures: Surface Elevation and Vertical Sediment Accretion

2.2 Project Goals, Objectives and Constraints

The study goals, objectives, and constraints were developed to comply with the study authority and to respond to the problems and opportunities for the Southwest Coastal Study Area. In consultation with the non-Federal sponsor and other interested parties, goals and objectives were developed during steps one and two of the planning process. These goals, objectives and constraints, and the CEM were used during the AM&M planning process to develop the performance measures and risk endpoints for the project. See Section 3.1.

Overarching Project Goal: To reduce storm surge flooding and coastal storm damages to provide sustainable ecosystem restoration.

Planning Objectives:

- NED Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.
  Metric: reduction in annual damage costs.
  Data required: average annual expenditures on repairs due to storms and storm surges.
  Data collection: inputs for HEC-FDA, HEC-RAS, state master plan, and ADCIRC.

Please note that Objective 1 is not addressed by the NER components and is not addressed within this AM&M plan.

- NER Objective 2. Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.

- NER Objective 3. Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.

- NER Objective 4. Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.

- NER Objective 5. Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

Planning Constraints

The NED and NER plans are limited by the following constraints that are to be avoided or minimized:

- Commercial navigation. The Calcasieu and Sabine Ship Channels and the Gulf Intracoastal Waterway (GIWW) carry significant commercial navigation traffic. Measures that would cause shipping delays would result in negative NED impacts. In addition, the ability of authorized navigation projects to fulfill their purpose, such as the operation of locks along the GIWW, may be impacted by project features.
- Federally threatened and endangered species and their critical habitats includes consideration of dredge pipeline placement onto designted piping plover critical wintering habitat and consideration of dredging operations with regard to sea turtles.
- Must include consideration of other species of concern and development of a bird abatement plan to prevent nesting by shorebirds during construction activities.
- Marine Mammal Protection Act Best Management Practices (BMP) guidance; sea turtle and gulf sturgeon Protection Measures during dredging activiies; avoidance of bald eagle nests, and colonial nesting waterbirds rookeries.
- Essential fish habitat (EFH), especially intertidal wetlands. Conversion of one EFH type to another should be done without adversely impacting various fish species.

- Historic and cultural resources. Ninety-nine archeological sites have been identified within a one-mile buffer of NED and NER alternatives, including one historic site ("Arcade Theater") listed on the National Register of Historic Places (NRHP) and six potentially eligible prehistoric sites. Twelve historic properties listed on the NRHP have been identified within the one-mile buffer, including the Charpentier (Lake Charles) Historic District, as well as four eligible standing structures. Hundreds of standing structures in the area have a minimum age of 50 years and have not been assessed for eligibility.

2.3 Management and Restoration Actions — Tentatively Selected Plan

The PDT performed a thorough plan formulation process to identify restoration and management actions that best meet project goals and objectives. For more information on the plan formulation process see Chapter 2 of the Feasibility Report. For more information on the NER Tentatively Selected Plan (TSP) see Chapter 4 of the Feasibility Report.

The NER TSP is comprised of 4 ecosystem restoration measure types as follows and described in Table 1:

- 9 Marsh restoration features totaling 8,714 acres. 2,083 acres of saline marsh and 1,905 acres of brackish marsh in the Calcasieu-Sabine Basin and 4,726 acres of brackish marsh in the Mermentau/Teche-Vermilion Basin.
- 35 Chenier reforestation locations totaling 1,414 acres. Measures would reforest chenier forests and improve a net total of 1,132 acres of habitat in the Calcasieu-Sabine Basin and 282 acres of habitat in the Mermentau/Teche-Vermilion Basin.
- 5 shoreline protection projects
- 1 hydrologic/salinity control feature

Table 1. NER Project Features

Feature	Description	Acres Restored/ Nourished/ Protected
Marsh Restoration		
47a1	Marsh restoration using dredged material south of LA-82, about 4.5 miles west of Grand Chenier. 933 marsh acres would be restored and 88 acres would be nourished from 3M cubic yards of dredged material with one renourishment cycle.	895
47a2	Marsh restoration using dredged material south of LA-82, approximately 4.5 miles west of Grand Chenier. 1,297 marsh acres would be restored and 126 acres would be nourished from 8.8M cubic yards of dredged material with one renourishment cycle.	1,218
47c1	Marsh restoration using dredged material south of LA-82, approximately 4.5 miles west of Grand Chenier. 1,304 marsh acres would be restored and 4 acres would be nourished from 8.6M cubic yards of dredged material with one renourishment cycle.	1,135
127c3	Marsh restoration at Pecan Island, west of the Freshwater Bayou Canal and approximately 5 miles north of the Freshwater Bayou locks. 832 marsh acres would be restored and 62 acres would be nourished from 7.3M cubic yards of dredged material with one renourishment cycle.	735
306a1	Rainey marsh restoration at Christian Marsh, east of the Freshwater Bayou Canal and approximately 5 miles north of the Freshwater Bayou locks. 627 marsh acres would be restored and 1,269 acres would be nourished from 8.1M cubic yards of dredged material with one renourishment cycle.	743
3a1	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the south shore of the GIWW west of the Calcasieu Ship Channel near Black Lake. Restore 599 marsh acres with 5.3M cubic yards of dredged material with one renourishment cycle.	454
3c1	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the eastern rim of Calcasieu Lake and situated within the Cameron-Creole Watershed area. 1,765 marsh acres would be restored and 450 acres would be nourished from 10.2M cubic yards of dredged material with one renourishment cycle.	1,451
124c	Marsh restoration at Mud Lake. Located adjacent and north of Highway 82 and east of Mud Lake. 1,908 marsh acres would be restored and 734 acres would be nourished from 11.1M cubic yards of	1,915

Feature	Description	Acres Restored/ Nourished/ Protected
	dredged material with one renourishment cycle.	
124d	Marsh restoration at Mud Lake. Located west of the Calcasieu Ship Channel and adjacent to the south rim of West Cove. 159 marsh acres would be restored and 448 acres would be nourished from 1.4M cubic yards of dredged material with one renourishment cycle.	168
Chenier Reforestation		
CR	35 separate chenier locations would be replanted. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated.	1,413
Shoreline Protection/ Stabilization		
5a	Holly Beach Shoreline Stabilization Breakwaters. Construction of 8.7 miles of rock and low action breakwaters and is a continuation of existing breakwaters. Crown elevation of +1.5 ft with a crown width of 30 ft. Two maintenance lifts will be required.	26
6b1	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 11.1 miles of Gulf shore protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore consisting of geotextile fabric and stone built to an 18 ft crest width.	2,140
6b2	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 8.1 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and stone built to an 18 ft crest width.	1,583
6b3	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 7.2 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and stone built to an 18 ft crest width.	1,098
16b	Fortify spoil banks of Freshwater Bayou. Approximately 15.4 miles of rock revetment at three critical locations to prevent shoreline breaching. Rock revetment would be built to +4 ft with a 4 ft crown. Two maintenance lifts will be required.	662
Hydrologic/ Salinity Control		
74a	Cameron-Creole Spillway. Located at the breach in the levee south of Lambert Bayou this canal, managed with flap-gates culverts built to +2 ft, would act as a drainage manifold. The outfall channel into Calcasieu Lake would rock-lined for scour protection.	1,395*

** Accomplished through the evacuation of wetland-damaging storm surge-deposited water from behind the Cameron-Creole levee during storm events*

Construction of the NER project features will be phased. The TSP project features will be implemented in 3 sequential tiers to avoid potential borrow, staging and construction issues. All projects within a Tier could be constructed concurrently with the exception of shoreline protection features which would be constructed prior to marsh creation features in order to provide immediate protection of the marsh creation features. Subsequent phases of construction would be instituted after completion of projects in the previous Tier. The implementation plan assumes that all construction funds would be available, multiple construction contracts could be let at one time, and an adequate supply of all materials to facilitate construction.

Tier I Projects:

- Beneficial Use of Dredged Material from Calcasieu Ship Channel (3a1)
- Beneficial Use of Dredged Material from Calcasieu Ship Channel (3c1)
- Holly Beach Shoreline Stabilization – Breakwaters (5a)
- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b1)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bSE)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bNE)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bW)
- Marsh Restoration Using Dredged Material South of Highway 83 (47a1)
- Cameron Spillway Structure at East Calcasieu Lake (74a)

- Marsh Creation at Mud Lake (124d)
- Marsh Restoration at Pecan Island (127c3)
- Chenier Ridges: Grand Chenier Ridge (416)
- Restore Bill Ridge (509c)
- Chenier Ridges: Cheniere au Tigre (509d)
- Restore Blue Buck Ridge (510a)
- Restore Hackberry Ridge (510b)
- Restore Front Ridge (510d)

Tier II Projects:

- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b2)
- Marsh Restoration Using Dredged Material South of Highway 83 (47a2)
- Marsh Creation at Mud Lake (124c)
- Rainey Marsh Restoration Southwest Portion (Christian Marsh) (306a1)

Tier III Projects:

- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b3)
- Marsh Restoration Using Dredged Material South of Highway 83 (47c1)

2.4 Sources of Uncertainty and Associated Risks

A fundamental tenet underlying AM is decision making and achieving desired project outcomes in the face of uncertainties. The AM&M Program provides a framework for identifying, analyzing and managing the uncertainties for the Southwest Coastal Restoration Project. Scientific uncertainties and technological challenges are inherent with any large-scale restoration project with the principal sources of uncertainty typically including (1) incomplete description and understanding of relevant ecosystem structure and function, (2) imprecise relationships between project management actions and corresponding outcomes, (3) engineering challenges in implementing project alternatives, and (4) ambiguous management and decision-making processes. It is important to determine the type of risk each uncertainty comprises and to discern what constitutes sufficient knowledge to proceed considering those risks.

Identified uncertainties and risks associated with the Southwest Coastal Restoration Project include:

- Relative sea level rise (subsidence plus eustatic variability)
- Climate change, such as drought conditions and variability of tropical storm frequency, intensity, and timing
- Inherent natural variability in ecological and physical processes
- Subsidence, accretion salinity, and water level trends and impacts:
    - Subsidence rates (+/-) throughout the project life and the impacts on constructed project features
    - Accretion rates (+/-) throughout the project life and the impacts on constructed project features
    - Water level trends (+/-) throughout the project life and the impacts on constructed project features
    - Variable salinities that impact vegetation
- Wetland water, sediment, and nutrient requirements:
    - Magnitude and duration of inundation
    - Annual sediment requirements
    - Nutrients required for desired productivity
- Impacts to belowground and aboveground biomass due to changes in hydro period and duration

- Vegetation impacts due to herbivory, grazing and girdling
- Potential failure of vegetative plantings due to salt water intrusion
- Vegetation impacts due to invasive species removal including spraying
- Ability to infer operational changes based on data collected, especially from variable metrics such as aboveground and belowground biomass measurements
- Unanticipated cumulative effects
- Potential sinking of construction project features including shoreline protection and breakwaters
- Socio-economic and cultural
    - Changes to commercial activity
    - Effect on recreational activities
    - Potential impacts to historic and cultural resources
    - Ramifications to traditional activities, especially for indigenous and minority groups
    - Changes to community structure and integrity
- Development in or near the restoration sites, in particular oil and gas development, mining, and vegetation removal from cheniers
- Ecological and engineering challenges of hydrologic and salinity control in southwest Louisiana
- Project feature implementation including schedule and timeline, availability of construction funds, availability or multiple construction contracts and an adequate supply of all materials to facilitate construction.

Issues such as climate change, sea level rise, and regional subsidence are significant scientific uncertainties for all coastal Louisiana projects. These uncertainties were incorporated in the plan formulation process and will be monitored by gathering data on water levels, salinities, and land elevation. Specifically, for relative sea level rise (RSLR) USACE EC-1165-2-21 provides an 18-step process for developing a "low", "intermediate" and "high" future relative sea level rise scenario and provides guidance to incorporate these potential effects into project management, planning, engineering, design, construction, operation and maintenance. The PDT evaluated the final array of alternatives under three potential future RSLR scenarios in accordance with EC-1165 (See Feasibility Study Engineering Appendix B). This information will be assessed and will inform AM actions (see Section 6). In addition, procedures to evaluate sea level change impacts, response and adaption will continued to be examined under USACE ETL 1100-2-1 which provides guidance for understanding the direct and indirect physical and ecological effects of projected future sea level change on USACE projects and systems of projects and considerations for adapting to those effects.

2.5 Rationale for Adaptive Management/ Uncertainty and Risk Management

The primary reason for implementing AM&M is to increase the likelihood of achieving desired project outcomes given the uncertainties identified in Section 2.4. Adaptive management works best when it is tailored to the specific problem(s), designed to ensure accountability and enforceability, used to promote useful learning, and supported by sufficient funding (Doremus *et al.*, 2011). Although all restoration projects are required to consider AM, there may be some projects or increments of a project for which AM may not be applicable. AM is warranted when there are consequential decisions to be made, when there is an opportunity to apply learning, when the objectives of management are clear, when the value of reducing uncertainty is high, and when a monitoring system can be put in place to reduce uncertainty (Williams *et al.*, 2007). Adaptive management should not be used where or when mistakes may be irreversible, when learning is unlikely on the relevant time scale, or where no opportunity exists to revise or reevaluate decisions (Doremus *et al.*, 2011).

Several questions were considered to determine if AM should be applied to the project, given identified uncertainties:

1) Are the ecosystems to be restored sufficiently understood in terms of hydrology and ecology, and can project outcomes be accurately predicted given recognized natural and anthropogenic stressors?

2) Can the most effective project design and operation to achieve project goals and objectives be readily identified?
3) Are the measures of this restoration project performance well understood and agreed upon by all parties?
4) Can project management actions be adjusted in relation to monitoring results?

There are significant ecological and engineering challenges associated with hydrologic and salinity control in southwest Louisiana, especially when confronting critical uncertainties associated with the effects of climate change and relative sea level rise. Previous hydrologic restoration efforts in southwest Louisiana have illustrated the sensitivity of these coastal marsh systems to hydrologic modification, whether through natural or anthropogenic events, and the importance of sufficient data to actively make decisions regarding management actions over time.

A 'NO' answer to questions 1-3 and a "YES" answer to question 4 qualifies the project as a candidate that could benefit from AM. The AM&M Team and the PDT determined that the Southwest Coastal Restoration Project meets these qualifications, and, therefore, is a candidate for AM and the AM&M plan would be developed to reduce critical uncertainties and provide the data necessary to make decisions to adjust project performance in response to monitoring results.

3. MONITORING

Independent of AM, an effective monitoring program is required to determine if project outcomes are consistent with original restoration goals and objectives. The strength of a monitoring program developed to support AM lies in the establishment of feedback between continued project monitoring and corresponding project management. The CECW-PB Memo dated 31 August 2009, requires monitoring that: *"…includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether Adaptive Management may be needed to attain project benefits."*

Pre-construction/baseline date, during construction, and post-construction monitoring will be utilized to determine restoration success. Monitoring will continue until the trajectory of ecological change and/or other measures of project success are determined as defined by project-specific objectives. Section 2039 of the WRDA 2007 allows ecological success monitoring to be cost-shared for up to ten years post-construction. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring would be performed. If ecological success cannot be determined within the ten-year post construction period of monitoring, any additional required monitoring will be a non-Federal responsibility.

Monitoring activities will utilize all existing data where possible and available, such as remotely sensed data, where necessary to assess changes resulting from restoration. When possible, project monitoring and information needs will be integrated with existing monitoring efforts that are underway in coastal Louisiana. For example, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program has been monitoring restoration and coastal wetland protection projects in coastal Louisiana since 1990 (Steyer and Stewart 1992, Steyer et al., 1995). The CWPPRA monitoring program incorporates a system-level wetland assessment component called the CRMS (Wetlands, Steyer et al., 2003). CRMS-Wetlands provides system-wide performance measures that are evaluated to help determine the cumulative effects of restoration and protection projects throughout much of coastal Louisiana. Consequently, the project Monitoring Plan incorporates existing monitoring networks to the extent practicable. Such participation can maintain the data consistencies necessary to conduct not only individual restoration project but also coast wide programmatic AM&M. Additional data will be collected as part of Southwest Coastal (1) if required, or (2) only if scientifically defensible to achieve a complete dataset in which to compare post-restoration success.

3.1 Monitoring Plan Elements

Defining and assessing progress towards meeting project objectives are crucial components of the AM&M program. Table 2 outlines the proposed performance measure metrics, desired outcomes and monitoring design needed to measure restoration progress, determine ecological success and support the AM program

should changes need to be made to improve project performance. The elements described in this section are based on the available programmatic project information and will be updated and refined further during the detailed feasibility level of design phase as the details of the individual project measures are available. Regional/Basin and feature specific plans and details will be developed in PED.

Table 2: Proposed NER performance measures, desired outcomes and monitoring design

Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.	
Objective 1 is related to the NED project component and will not be monitored or adaptively managed and thus is not incorporated into this MAM plan design.	
Objective 2. **Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.**	
Performance Measure:	Tidal Flows
Desired Outcome:	To improve circulation patterns that facilitate water drainage and reduce intrusion of high salinity events in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Synoptic hydrologic surveys, using salinity, temperature, dissolved oxygen, and velocity as tracers, will be conducted to track distribution of water. Sampling will be conducted every two months for two years pre-project and two years post-project or until desired outcomes are achieved. Two observation periods immediately post-construction will be conducted to detect immediate changes. Continuous water surface elevation, current velocity, salinity and turbidity will be monitored at six locations within the Cameron Creole Watershed and three locations in the lower Mermentau River. Existing USGS and LDWF monitoring locations will be utilized, as appropriate.
Performance Measure:	Salinity
Desired Outcome:	To minimize salinity conditions that stress fresh and intermediate marsh communities in Cameron Creole Watershed and lower Mermentau Basin (hypothesize growing season average less than 2ppt in fresh and 6ppt in intermediate marsh)
Monitoring Design:	Hourly salinity recorders will be deployed in the six hydrological sites in the Cameron-Creole Watershed and three hydrologic sites in the lower Mermentau River and correlated to the soils and vegetation data that will also be collected. The sites will be sampled for a period of 2 years pre-project and for a period of 10 years post-project construction or until desired outcomes are achieved. Hourly salinity measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
Objective 3. **Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.**	
Performance Measure:	Hydroperiod
Desired Outcome:	To reduce depth, duration and frequency of marsh flooding that stress fresh and intermediate marsh communities (hypothesize less than 60% between March 1and September 30) in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Continuous water-level recorders surveyed to marsh elevation (in NAVD88) will be deployed at all biomass sites to measure hydrologic conditions. Recorders will be established 2 years prior to construction to determine existing conditions and will be monitored for 10 years post-construction or until desired outcomes are achieved. Hydroperiod measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
Performance Measure:	Aboveground biomass
Desired	Increase aboveground biomass by 20% in Cameron Creole Watershed and lower

Outcome:	Mermentau Basin
Monitoring Design:	Aboveground biomass will be sampled quarterly at 10 vegetation sites (5 in fresh marsh and 5 in intermediate marsh) within the Cameron Creole Watershed and within the Mermentau Basin in proximity to water control structure locations. Permanent vegetation monitoring stations will be established for assessing project area vegetation community and aboveground biomass changes due to salinity and inundation control. These stations will be sampled for community composition and aboveground biomass for a two year period to assess pre-project conditions and sampled during two 2-year periods during the 10-year post-project period. Biomass stations will be co-located at existing CRMS stations if appropriate.
Performance Measure:	Belowground biomass
Desired Outcome:	Increase belowground biomass by 20% in Cameron Creole Watershed and lower Mermentau Basin
Monitoring Design:	Belowground biomass will be sampled quarterly at 10 vegetation sites (5 in fresh marsh and 5 in intermediate marsh) within the Calcasieu/Sabine Basin in proximity to SW Coastal water control structure locations. Permanent vegetation monitoring stations will be established for assessing project area vegetation community and aboveground biomass changes due to salinity and inundation control. These stations will be sampled for community composition and belowground biomass for a two year period to assess pre-project conditions and sampled during two 2-year periods during the 10-year post-project period. Biomass stations will be co-located at existing CRMS stations if appropriate.
Performance Measures:	Elevation, Accretion, Subsidence
Desired Outcome:	Maintain elevation sufficient to support vegetation and marsh establishment
Monitoring Design:	One rod-surface elevation table (SET) and replicate feldspar stations will be established at all biomass sites and sampled semi-annually for a period of 2 years pre-project and for a period of 10 years post-project or until desired outcomes are achieved. Elevation, accretion and subsidence measured at existing CRMS stations (fresh and intermediate marsh) throughout the Cameron Creole Watershed and Mermentau Basin will be utilized, as appropriate.
Objective 4. **Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.**	
Performance Measure:	Shoreline Change
Desired Outcome:	Reduction in shoreline erosion rate below the historic average (1998-2012).
Monitoring Design:	Historic erosion rates will be established from historic aerial photography. Photography and DGPS surveys will be used to determine erosion rates post construction. Shoreline surveys will be conducted in areas with project features and surrounding and reference areas. One pre-construction and four post-construction acquisitions will be obtained.
Desired Outcome:	Reduce loss of adjacent wetlands
Monitoring Design:	Land:water acreage will be classified using Landsat TM scenes collected in 3 pre- and 10 post-project years and vegetated habitats will be classified using digital orthophoto imagery for 1 pre- and 2 post-project years, as well as any available field data in the study area to assess land:water trends, habitat distribution and land loss.
Objective 5. **Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.**	
Performance Measure:	Land Acreage/Habitat and land:water classification
Desired Outcome:	Increase acreage of marsh and shoreline habitats by an average of 10,000 acres per basin (Calcasieu/Sabine, Mermentau, Teche-Vermillion)
Monitoring Design:	Land:water acreage will be classified using Landsat TM scenes collected in 3 pre- and 10 post-project years and vegetated habitats will be classified using digital orthophoto imagery for 1 pre- and 2 post-project years, as well as any available field data in the study area to assess land:water trends and habitat distribution.
Performance	Marsh Elevation

Measure:		
	Desired Outcome:	Maintain elevation to support vegetation and marsh establishment
	Monitoring Design:	Establish settlement plates within the constructed marsh footprint to measure changes in elevation of the sediment rod over time.
Performance Measure:		Chenier Tree Coverage
	Desired Outcome:	Increase in chenier tree canopy and understory coverage by 30%.
	Monitoring Design:	Diameter at breast height (dbh) and overstory tree cover will be measured two pre-construction years and four post-construction years (within the first 10 years). Understory vegetation (herbaceous, seedling, and sapling) will be measured two pre-construction and four post-construction years (within the first 10 years) to assess regeneration and changes in cover classes.
	Desired Outcome:	Survival and increase in diameter of chenier plantings in project area. Planted cypress and tupelo seedlings at 435 seedlings per acre will have a 70 percent survival rate in target years (TY) 1, 3, and 5, post-construction.
	Monitoring Design:	A sample of seedlings will be counted and measured in TY 1 post-construction and at TY 3 and 5 to access percent survival.

4. ASSESSMENT

The assessment phase of the implementation framework (Figure 3) compares the results of the monitoring efforts to the desired project performance measures and/or acceptable risk endpoints (i.e., decision criteria) that reflect the goals and objectives of the management or restoration action.

This assessment process will regularly measure the progress of the project in relation to the stated project objectives, performance measures and desired outcomes. Thorough and complete assessments are critical to the AM&M Program. The assessments will continue through the life of the project or until it is has been determined that the project has successfully achieved (or cannot achieve) its goals and objectives (Figure 2).

4.1 Assessment Process

During PED, the Assessment Team assigned will identify a combination of qualitative (i.e., professional judgment) and quantitative methods for comparing the values of the performance measures produced by monitoring with the selected values of these measures that define criteria for decision-making.

Appropriate statistical comparisons (e.g., hypothesis testing, ANOVA, multivariate methods, etc.) will be used to summarize monitoring data and compare these data with the stated metrics. These continued assessments will be documented as part of the project reporting and data management system.

The Assessment Team will collaborate with project managers and decision-makers to define magnitudes of difference (e.g., statistical differences, significance levels) between the values of monitored performance measures and the desired values that will constitute variances. Meaningful comparisons between monitoring results and desired performance will require characterization of historical and current spatial-temporal variability that define baseline conditions. Variances (or their absence) will be used to recommend AM actions, including (1) continuation of the project without modification, (2) modification of the project within original design specifications, (3) development of new alternatives, or (4) termination of operation of the Southwest Coastal project.

The CEM (Attachment 1) helps describe the linkages between stressors and performance measures and may be used to further define management actions based on the monitored results. The assessments will help determine if the observed responses are linked to the project; if the responses are undesirable (e.g., are moving away from restoration goals); or if the responses have met the specified success criteria. If

performance measures are not responding as desired, for example because the stressor has not changed enough in the desired direction, then recommendations should be made for modifications to the project. If the stressor has changed as expected/desired and the performance measure has not, additional research may be necessary to understand why.

During the PED phase, the frequency of assessments for the Southwest Coastal project will be determined by the relevant ecological scales of each performance measure. The project technical support staff will identify for each performance measure the appropriate timescale for assessment. An initial project assessment will be completed before construction. There will be post-construction project assessments as needed during the post-construction period; however the level of detail will depend on the timescale of expected responses, and frequency of data collection. At this time it is estimated that assessments will be, on average, every three years.

4.2 Documentation and Reporting

The Assessment Team will document each of the performed assessments and communicate the results of its deliberations to the managers and decision-makers designated for the Southwest Coastal Restoration Project. The Assessment Team will produce periodic reports that will measure progress towards project goals and objectives as characterized by the selected performance measures. The reporting of monitoring results and AM evaluations will be in the form of both Assessment Reports to include a high level of detail and science and management friendly summary Report Cards.

5. DATA MANAGEMENT

Data management is a vital component of the long-term monitoring plan and the overall adaptive management process. To maintain lasting value of the data collected, the data must be stored, organized, and archived in an efficient and intuitive structure, so that it may be used in the Assessment process (Section 4) to determine progress towards meeting project goals and be used to inform decision making and adaptive management actions (Section 6). Each distinct data type collected must comply with its specific data format, delivery, and metadata standard. These standards will be prescribed by the Data Management Team and managed by the AM&M Team. The detailed Data Management Plan will be developed during PED.

6. ADAPTIVE MANAGEMENT AND DECISION MAKING PROCESSES

Scientific, technological, socio-economic, engineering, and institutional uncertainties are challenges inherent with any large-scale ecosystem restoration project. A structured monitoring design for the Southwest Coastal Restoration Project will be implemented to provide the feedback necessary to inform decisions about future project adjustments. The project report card, drafted by the Assessment Team, will be used to evaluate project status and any potential adaptive management needs. The Assessment Team may submit recommendations for AM actions to the AM&M Team. The AM&M Team will investigate and further refine AM recommendations and present them to the Program Management Team. During project implementation and operation, it will be up to the District Commander and Non-Federal Sponsor to make a recommended AM action. If Project monitoring determines that a management trigger has been "activated" then there are three possible response pathways:

1. determine that more data is required and continue (or modify) monitoring;
2. identify and implement a remedial action; or
3. modify project goals and objectives (this option would *only* be considered as a last resort and upon careful consideration by and consensus of the Project Management Team).

The Phased Implementation and Tiering of the project features as described in Section 2.3 will allow for Adaptive Design and implementation of subsequent project features and Tiers. Lessons learned during the implementation of the initial project features in the earlier Tiers can be used to adjust the design and implementation of the later projects to better ensure project success. For example Marsh elevation targets can be revised based on amount of compaction and dewatering that occur in different marsh types/soil types/subsidence zones.

Additionally, potential adaptive management actions have been identified to account for the identified risks, uncertainties and unexpected environmental conditions that have been identified for the project. Implementation of these actions as a contingency plan will better ensure that the project is successful and able to meet the project stated objectives. These potential AM actions/contingency plan actions are presented below. The actions will be further evaluated and refined for inclusion in the final AM&M plan once the necessary project feature details become available. At that time specific triggers and thresholds will be developed for implementing the AM/contingency actions:

- Increasing wetland elevation by re-nourishment of marsh creation areas
- Additional vegetative plantings for marsh features may be needed due to risks such as herbivory, inundation and salinity impacts.
- Additional vegetative plantings for chenier features may be needed due to risks such as grazing, saltwater impacts, harvesting, tree guards, required spraying, etc.
- Further degradation of spoil banks to ensure successful ingress and egress for aquatic species.
- Modification of the operation of the water control structures to adjust the amount or timing of freshwater or nutrient inputs.

Project planning was based on the intermediate RSLR scenario. Based on the October 2011 guidance below projects adjustments to high RSLR may fall under AM. Potential options for AM actions based on RSLR increases include raising wetland elevation to account for an accelerated rate.

CECW Guidance Memorandum "Policy Guidance Request for Addressing Sustainability of Ecosystem Restoration Projects in Louisiana" (October 2011), indicates *while different levels of RSLR are evaluated during the course of a study to determine the robustness of the proposed solution, our current investment decisions are based on a discrete level of RSLR. Conceptually, if the rate of RSLR exceeds the rate used as the basis for the investment decision, then adaptive management measures above and beyond OMRR&R may be appropriate. This concept will have to be carefully vetted on a project by project basis so as to negate inappropriate transfers of cost from OMRR&R to adaptive management.*

Under this project potential adaptive management actions will continue to be developed in consideration of the guidance provided in the USACE ETL 1100-2-1 titled "Procedures to Evaluate Sea Level Change Impacts, Response and Adaption. The technical letter provides guidance for understanding the direct and indirect physical and ecological effects of projected future sea level change on USACE projects and considerations for adapting to those effects including consideration of a longer planning horizon and incorporating more robust management actions. Relevant sections are included below.

"Longer Planning Horizon. The planning, design, and construction of a large water resources infrastructure project can take decades. Though initially justified over a 50-year economic period of analysis, USACE projects can remain in service much longer. The climate for which the project was designed can change over the full lifetime of a project to the extent that stability, maintenance, and operation may be impacted, possibly with serious consequences, but also potentially with beneficial consequences. Given these factors, the project planning horizon (not to be confused with the economic period of analysis) should be 100 years, consistent with ER 1110-2-8159."

"Responses or Management Approaches. Uncertainty about the future can be identified not just with regard to sea level change or wider climate change processes but also with regard to morphological, ecological, and socioeconomic change. An overall adaptive management approach provides a process for dealing with all of these uncertainties and involves developing plans for the future that envisage a range of futures, incorporate ongoing monitoring, and permit transitions from one engineering approach to another. The approach gives freedom for different decision pathways to be followed depending on the magnitude and rate of sea level and other changes. This flexible and responsive adaptive management philosophy may require the consideration of modifications to how we think about project life, maintenance actions, ongoing decision-making, and funding methods, including increasing use of nonstructural measures for reducing the consequence element of risk."

7. LESSONS LEARNED

Collecting, identifying and documenting lessons learned is a goal of the am&m program. The am&m planning team will help develop and compile lessons learned, best practices and experiences concerning the implementation of the restoration program, technical and organizational challenges, and monitoring and adaptive management. Lessons and experiences will be clearly documented with recommendations where applicable so that they can be easily applied to future ecosystem restoration programs and projects. Documenting the lessons learned ultimately aims to reduce recurring, technical or programmatic issues that negatively impact cost, schedule, restoration project performance and success.

8. COSTS FOR IMPLEMENTATION OF ADAPTIVE MANAGEMENT AND MONITORING

The AM&M program establishes a feedback mechanism whereby monitored conditions will be used to adjust or refine construction and or maintenance actions to better achieve project goals and objectives. This AM&M Plan includes the minimum monitoring actions determined necessary to evaluate project success and provide the information needed to inform the adaptive management program. Section 2039 of the WRDA 2007 allows monitoring to be cost-shared for up to ten years post-construction. For cost estimating purposes, the maximum cost-shared period of monitoring will be assumed for all features. Once ecological success has been established, monitoring would cease. The need for additional monitoring would be assessed at the end of the cost-shared period, and any additional required monitoring would be a 100 percent non-Federal responsibility.

Costs associated with implementing this AM&M Program were estimated based on available data, and additional details regarding the proposed monitoring, AM opportunities and management actions and detailed costs estimates will continue to be be revised and asdeveloped as additional information becomes available. Because uncertainties remain as to the exact project features, monitoring elements, and AM opportunities and management actions and detailed costs estimates, will be need to be developed during the feasibility study in the feasibility level of design phase. For planning purposes cost for AM&M costs are currently budgeted atwere assumed to be 3% of the total project cost. This estimate includes the monitoring necessary to determine project success, data management and program and adaptive management.

The budget estimate of 3% of total project cost was identified based on the large geographic scale of the project, costs for similar programs and the risk and uncertainties described in Section 2.4 of the AM&M plan, and the potential need for the Adaptive Management actions described in Section 6. The significant ecological and engineering challenges of restoration, hydrologic and salinity control in southwest Louisiana, especially when confronting critical uncertainties associated with the effects of climate change and relative sea level rise were considered when developing the estimated costs. Previous hydrologic restoration efforts in southwest Louisiana have illustrated the sensitivity of these coastal marsh systems to hydrologic modification, whether through natural or anthropogenic events, and the importance of sufficient data to actively make decisions regarding management actions over time.

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Southwest Coastal Louisiana Feasibility Study

Conceptual Ecological Model

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1. INTRODUCTION

1.1 Conceptual Ecological Model (CEM) Definition

A conceptual model is a tentative description of a system or sub-system that serves as a basis for intellectual organization and represents the modeler's current understanding of the relevant system processes and characteristics (Fischenich 2008). These models, as applied to ecosystems (Conceptual Ecological Models or CEMs), should be simple, qualitative models, represented by a diagram which describes general functional relationships among the essential components of an ecosystem. CEMs typically document and summarize current understanding of, and assumptions about, ecosystem function. When applied specifically to ecosystem restoration projects, these models can be used as a basis for establishing the "Future-without Project Condition" and the benefits of proposed alternatives. To describe ecosystem function, a CEM usually diagrams relationships between major anthropogenic and natural stressors, biological indicators, and target ecosystem conditions.

A 2008 USACE Ecosystem Planning Center of Expertise White Paper on the certification of ecosystem output models recommended that conceptual models "be developed for all ecosystem restoration projects" (USACE 2008a). Further, they recommended that these models be reviewed as part of the normal ITR process and do not need certification". The 2008 Memorandum on Policy Guidance on Certification of Ecosystem Output Models (USACE) adopted this recommendation (USACE 2008b).

1.2 Purpose and Function of Conceptual Ecological Models

Conceptual Ecological Models have been widely used in other regions of North America in planning several large-scale restoration projects (Rosen et al 1995, Gentile 1996, Chow-Fraser 1998, Ogden and Davis 1999, Ogden et al 2003). The same approach can be used for a variety of restoration scales as the elements of conceptual models are common. CEMs created for restoration programs/projects should include:

- Those physical, chemical, and biological attributes of the system that determine its dynamics;
- The ways in which ecosystem drivers, both internal and external cause change with particular emphasis on those aspects of the system where the proposed project can effect change;
- Critical thresholds of ecological processes and environmental conditions;
- Assumptions and gaps in the state of knowledge, especially those that limit the predictability of restoration outcomes; and
- Current characteristics of the system that may limit the achievement of management outcomes.

The USACE is using CEMs to provide assistance with ecosystem simplification, communication, plan formulation, and science, monitoring, and adaptive management. The CEM format utilized here follows a top-down hierarchy of information using the format established by Ogden and Davis (1999) (Figure 1). It should be noted that CEM development is an iterative process, and that CEMs developed for USACE projects during early plan formulation may be modified through the life of the project.

1.2.1 Model Components

The schematic organization of the CEM is depicted in Figure 1 and includes the following components:

Drivers - This component includes major external driving forces that have large-scale influences on natural systems. Drivers may be natural (e.g., eustatic sea level rise) or anthropogenic (e.g., hydrologic alteration) in nature.

Ecological Stressors - This component includes physical or chemical changes that occur within natural systems, which are produced or affected by drivers and are directly responsible for significant changes in biological components, patterns, and relationships in natural systems.

Ecological Effects - This component includes biological, physical, or chemical responses within the natural system that are produced or affected by stressors. CEMs propose linkages between one or more ecological stressors and ecological effects and attributes to explain changes that have occurred in ecosystems.

Attributes- This component (also known as indicators or end points) is a prudent subset of all potential elements or components of natural systems representative of overall ecological conditions. Attributes may include populations, species, communities, or chemical processes. Performance measures and restoration objectives are established for each attribute. Post-project status and trends among attributes are measured by a system-wide monitoring and assessment program as a means of determining success of a program in reducing or eliminating adverse effects of stressors.

Performance Measures - This component includes specific features of each attribute to be monitored to determine the degree to which attribute is responding to projects designed to correct adverse effects of stressors (i.e., to determine success of the project).

This CEM does not attempt to explain all possible relationships or include all possible factors influencing the performance measure targets within natural systems in the study area. Rather, the model attempts to simplify ecosystem function by containing only information deemed most relevant to ecosystem monitoring goals.

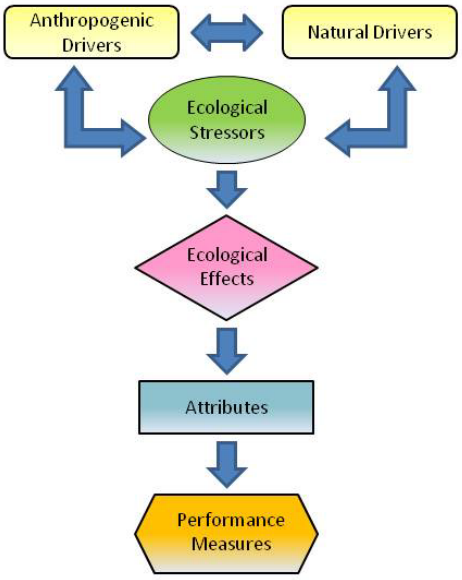

Figure 1: Conceptual ecological model schematic diagram

2. PROJECT BACKGROUND

2.1 Project Goals and Objectives

The goal of the study is to formulate a comprehensive plan for Southwest Coastal Louisiana that provides hurricane and storm damage risk reduction and coastal restoration measures to achieve ecosystem sustainability. Specific objectives include:

- Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.
- Objective 2. Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh.
- Objective 3. Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
- Objective 4. Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.
- Objective 5. Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

The project area of the Southwest Coastal Louisiana study includes the Parishes of Cameron, Calcasieu, and Vermilion (Figure 2). This area includes approximately 4.700 square miles and a population of 117,100.

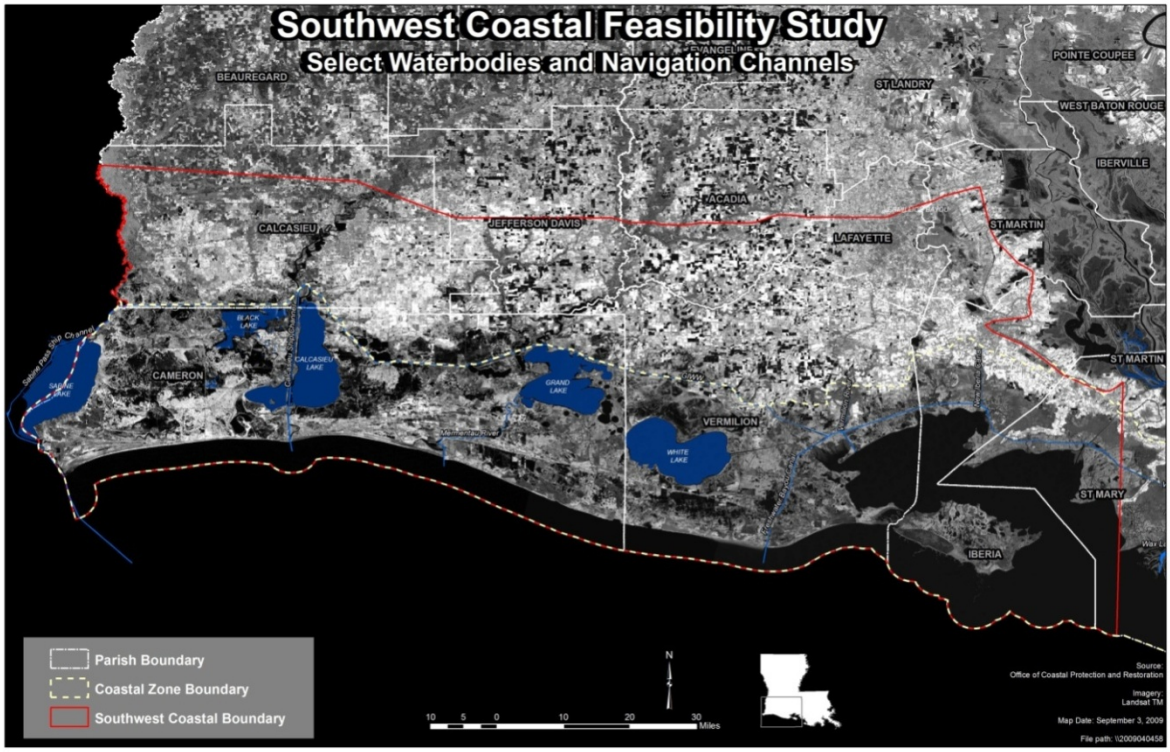

Figure 2: Southwest Coastal Louisiana – case study area map

3. CONCEPTUAL ECOLOGICAL MODEL DEVELOPMENT

The Southwest Coastal Louisiana CEM was developed by a New Orleans District led interagency team assisted by the Engineer Research and Development Center (ERDC) Environmental Lab. Prior to development of the model, the team reviewed existing information on ecological conditions in the project area. Using a workshop format, the team met to identify and discuss anthropogenically and naturally-driven alterations in the study area, stressors caused by these alterations, and consequent ecological effects. Additionally, key ecological attributes and indicators of project success were identified, along with potential performance measures. This information was used to form a set of working hypotheses and to consider the importance of each relationship **(Table 1**).

The project team used these hypotheses and lists of components to develop the model and to prepare this supporting narrative document to explain the organization of the model and science supporting the hypotheses.

Table 1: Working Hypotheses

NATURAL DRIVERS	
Hurricanes and Storms	The storm surge associated with hurricanes and storms causes increased erosion and subsequently a direct loss of the ridge /Chenier barrier system.
	The storm surge associated with hurricanes and storms causes increased saltwater intrusion to the coastal system which results in reduced primary productivity.
	Increased frequency and intensity of hurricanes and storms results in fragmentation of and eventually loss of wetlands.
Relative Sea Level Rise	The combination of sea level rise and subsidence leads to an amplification of the tidal prism/amplitude which can result in wetland degradation and an eventual conversion to open water.
	The combination of sea level rise and subsidence over the long term leads to saltwater intrusion into areas that would otherwise be fresh or brackish. This will cause changes in the biological community composition and an eventual conversion of marsh habitat to open water.
	The combination of sea level rise and subsidence over the long term leads to marsh fragmentation and eventually loss of wetlands.
ANTHROPOGENIC DRIVERS	
Hydrologic Alteration	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in altered circulation patterns which have led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in an increased tidal prism/amplitude which has led to an increase in wetland loss.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in saltwater intrusion which has led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have caused an increase in flood duration which has led to habitat conversion and changes in the biological community composition.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have caused an increase in flood duration which has led to a reduction in primary productivity.
	Alterations in the natural hydrology of coastal Louisiana, including the creation of navigation channels and water control structures, have resulted in marsh fragmentation and eventually wetland loss.
Mineral/Sediment Extractions	Mineral and Sediment extractions from the Chenier Plain has resulted in a direct loss of the ridge and Chenier barrier system.
	Mineral and Sediment extractions from the Chenier Plain has resulted in an increase susceptibility to saltwater intrusion into areas that would otherwise be fresh or brackish. This will cause changes in the biological community composition and an eventual conversion of marsh habitat to open water.
	Mineral and Sediment extractions from the Chenier Plain has resulted in an increase susceptibility to storm surge from hurricanes and storms which could result in a direct loss of the ridge and Chenier barrier system.
Sediment Supply	A decrease in sediment supply due to alterations in the Mississippi River for flood control and navigation exacerbates shoreline erosion. This results in an increase in the loss of the ridge and Chenier barrier system and coastal wetlands.
	A decrease in sediment supply due to alterations in the Mississippi River for flood control and navigation contributes to the fragmentation and ultimately the loss of coastal marshes.

4. CONCEPTUAL ECOLOGICAL MODEL

The CEM developed by the team for the Southwest Coastal Louisiana Feasibility Study is presented below (**Figure 3**). The model depicts the series of working hypotheses formed by the team (**Table 1**), arranged in a conceptual diagram. Relationships expressed with thicker or bolder arrows are more certain than those represented by thinner arrows. Model components are identified and discussed in the following subsections along with further explanation of the relationships between the components.

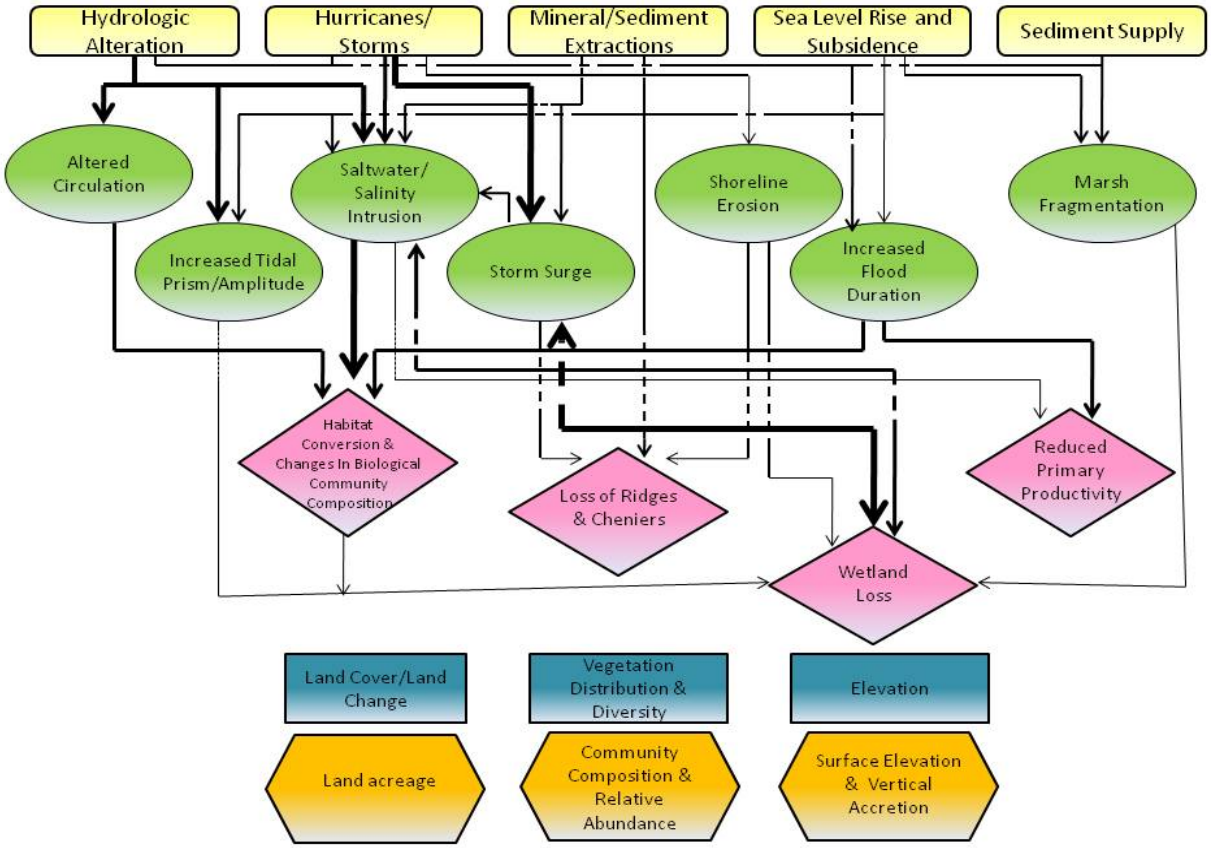

Figure 3. Southwest Coastal Louisiana conceptual model

4.1 Drivers

Drivers are the major external driving forces that have large-scale influences on Southwest Louisiana's coastal system. Anthropogenic drivers (e.g., hydrologic alteration) provide opportunities for finding solutions to problems. For instance, hydrologic alterations can be undone through modification of channels and canals either temporarily or permanently, and mineral/sediment extraction practices can be changed. Natural drivers, however, cannot be influenced directly; e.g. we cannot change the frequency or intensity of tropical storms or change how high or fast sea level rises. Some drivers are both anthropogenic and natural in nature. On a large, historical scale, sediment deposition has been determined by geological forces. On a local scale, sediments can be brought into the system from outside the system, or can be moved from where they are a hindrance (navigation channels) to where they are beneficial (marsh restoration sites).

The study team identified five main drivers that influence the project area on a large scale.

D1: Relative Sea Level Rise (Sea Level Rise and Subsidence)

D2: Numerous Hurricanes and Storms

D3: Hydrologic Alteration

D4: Sediment Supply to the Chenier Plain

D5: Mineral and Sediment Extraction

4.1.1 Relative Sea Level Rise

Relative sea level rise (RSLR) consists of eustatic sea level rise combined with subsidence. Eustatic sea level rise is defined as the global increase in oceanic water levels primarily due to changes in the volume of major ice caps and glaciers, and expansion or contraction of seawater in response to temperature changes. The International Panel on Climate Change (IPCC) estimates that average eustatic sea level rise since 1961 has been 1.8 mm per year, and since 1993, 3.1 mm per year (IPCC 2007). Additionally, there is a projected rise between 182 and 610 mm in the next century (IPCC 2007). In coastal Louisiana, this rise in sea level is exasperated by rapid changes in land elevation.

Subsidence is the decrease in land elevations due to compaction of Holocene deposits, consolidation of sediments, and faulting. Anthropogenic activities such as sub-surface fluid extraction and drainage for agriculture, flood protection, and development are also contributors to land elevation decreases. Forced drainage of wetlands results in lowering of the water table resulting in accelerated compaction and oxidation of organic material Areas under forced drainage can be found throughout coastal Louisiana and the study area. Each process produces a range of subsidence rates dependent on local environmental factors and each process occurs across a unique set of scale (Reed and Yuill 2009). The mean subsidence rate for Louisiana is 11 mm (0.43inches) per year (Berman 2005).

This combination of sea level rise and rapid subsidence, as well as natural and man induced erosional processes, has resulted in extensive wetland loss in coastal Louisiana. Rates for RSLR along coastal Louisiana are currently estimated to be between 1 to 1.2 m/century (USACE 2004). These are the highest rates of RSLR along the contiguous United States.
RSLR affects project area marshes by gradually inundating marsh plants. Marsh soil surfaces must vertically accrete to keep pace with the rate of relative sea level rise. Changes in land elevation vary spatially along coastal Louisiana, however in areas where subsidence is high and riverine influence is minor or virtually nonexistent wetland habitats sink and convert to open water.

Land elevations increase as a result of sediment accretion (riverine and littoral sources) and organic deposition from vegetation. Vertical accretion in most of the study area, however, is insufficient to offset subsidence. The combination of subsidence and eustatic sea level rise is likely to cause the landward movement of marine conditions into estuaries, coastal wetlands, and fringing uplands (Day and Templet 1989; Reid and Trexler 1992).

4.1.2 Hurricanes and Storms

The Gulf Coast region is affected by tropical and extra-tropical storms. These atmospherically driven storm events can directly and indirectly contribute to coastal land loss through: 1) erosion and breaches from increased wave energies; 2) removal and/or scouring of vegetation from storm surges; and 3) storm induced saltwater intrusion into interior wetlands. These destructive processes can result in the loss and degradation of large areas of coastal habitats in relatively short periods of time (days and weeks versus years). Since 1893, over 130 tropical storms and hurricanes have struck or indirectly impacted Louisiana's coastline. On average, a tropical storm or hurricane affects Louisiana every 1.2 years. The most recent tropical cyclones to affect the study area were Hurricanes Katrina and Rita, which occurred in August 2005 and September 2005, respectively, and Hurricanes Gustav and Ike, which occurred in September 2008. Storm surge and wave field associated with the 2005 storms eroded 527 km^2 of wetlands within the Louisiana coastal plain (Barras et al 2008).

Hurricane Rita was the fourth-most intense Atlantic hurricane ever recorded and the most intense tropical ever observed in the Gulf of Mexico. The storm generated a surge of up to 5 meters in some areas, driving saltwater tens of kilometers inland killing wetlands in artificially impounded areas. Rita made landfall between Sabine Pass, Texas and Johnson's Bayou, Louisiana causing extensive damage to Louisiana's southwest coastal parishes. Coastal communities in Cameron Parish were destroyed; the communities of Holly Beach, Hackberry, Creole, Grand Chenier, and Cameron were severely impacted. The Calcasieu Parish communities of Sulphur, Westlake, and Vinton also suffered significant damage and parts of the City of Lake Charles experienced 2 to 3 meter deep flooding associated with surge propagating up a ship channel.. Six people lost their lives and 10,000 structures were flooded. Rita caused $9.4 billion in damage along the Louisiana and southeastern Texas coasts.

Additionally, hurricane impacts to coastal environments can include sediment overwash, ripped and torn marsh, erosion of pond and lake margins, wrack (large amounts of plant debris) deposition, and lateral compression of marshes. Substantial sediment deposition associated with the passage of the storm can result in the burial of the pre-storm surface and the smothering of vegetation (Dunbar et al. 1992, Jackson et al. 1992). This same effect may occur as a result of burial by wrack. Extensive areas of marsh can be pushed against firm barriers (for example, levees and firmly grounded marsh) and can result in a ridge and trough. Freshwater marsh species can experience a "burning" effect (aboveground portions of the plants are killed) if exposed to saline waters (Dunbar et al. 1992, Jackson et al. 1992, Stone et al. 1993, Stone et al. 1997). In some marsh zones, unconsolidated or weakly rooted marsh has been eroded. Storms and hurricanes, depending on strength and intensity, can also blow over, defoliate, and/or cause major structural damage to trees well beyond the coastal zone (Lovelace 1998).

4.1.3 Hydrologic Alterations

Hydrologic alterations, including navigation channels and water control structures, are predominant sources of stress on the southwest Louisiana coastal system. These alterations cause disruptions in the natural coastal hydrological processes causing changes in circulation and tidal prism, and by increasing saltwater intrusion into the freshwater interior.

Altered hydrology is exacerbated by additional physical changes made in the watershed, which include canal, roads, and levees. Canals and associated spoil banks, constructed for navigation and/or oil and gas development, can be found throughout the project area. Canals impact wetlands by changing the normal hydrologic pattern. Canals deprive existing natural channels of water and allow more rapid runoff of water than the slower shallower natural channels do. This allows for greater fluctuation in the marsh and a lowering of the minimum water level which dry the marsh (Mitsch and Gosslink 2000).

These hydrologic alterations (e.g. cutting channels and canals, and the artificial creation of spoil banks) have also led to increased coastal habitat fragmentation. Hydrologic connectivity in the Chenier Plain has been disrupted by several activities, most notably the creation of navigational channels, such as the Sabine/Neches Waterway, Calcasieu Ship Channel, GIWW, Mermentau Ship Channel, and Freshwater Bayou Canal Navigational channel, and the creation of water control structures, such as the Calcasieu and Leland Bowman locks, the Freshwater Bayou Canal Lock, the Schooner Bayou Canal Structure, and the Catfish Point Control Structure. These channels have disrupted the hydrology of the region by facilitating saltwater intrusion into the historic freshwater interior. Water control structures were subsequently constructed in part to control the amount of saltwater intrusion into the interior, but further altered the hydrology by managing water flow. Together, these alterations have acted to change the hydrologic pattern of the Chenier Plain.

Through the creation of dredge material banks, roads and highways, and flood protection levees, some wetland habitats within the Chenier Plain have also become hydrologically isolated. During extreme water events, such as tropical storms, these habitats are particularly vulnerable due to their slow drainage patterns and the often resultant ponding of salt water throughout the wetlands. In such cases, the typical result has been ponding of water over the wetlands, often with high salinity content. This excessive ponding over an extended period of time in certain types of wetland habitats can kill the vegetative communities and result in

wetland loss and eventual conversion to open water. Near 100percent mortality of marsh vegetation in many areas has been documented as a result of high salinity water brought in by storm surge.

The spoil banks associated with these channels and canals reduce sheetflow of water across the wetlands (Swenson and Turner 1987) and prevent the exchange of sediment and nutrients and cause artificially prolonged flooding. These effects combine to eliminate soil-building processes necessary to counteract subsidence (USACE 2004, USACE 2010). In addition canal constructions can cause secondary indirect impacts such as accelerating erosion rates along the channel and canal banks.

Channels and canals provide avenues for higher salinity water to move into previously freshwater marshes, which ultimately leads to habitat degradation and land loss. By altering salinity gradients and patterns of water and sediment flow through marshes, channel and canal dredging indirectly changed the processes essential to a healthy coastal ecosystem and led to habitat conversion. Channels and canals that stretch from the Gulf of Mexico inland to freshwater areas allow saltwater to penetrate much farther inland, particularly during droughts and storms, which has had severe effects on freshwater wetlands (Wang 1987). Extreme salinity changes can stress fresh and intermediate marshes to the point where vegetation dies and the wetlands convert to open water (Flynn et al. 1995).

4.1.4 Sediment Supply

The Chenier Plain was developed as the result of the interplay of three coastal plain rivers (Sabine, Calcasieu, and Mermentau Rivers), cycles of Mississippi River Delta development, and the Gulf of Mexico. During periods of active Mississippi River delta building, Gulf of Mexico currents transported fine-grained sediments (clay and silt) in an East to West direction along the Louisiana coast. When delta formation occurred in shallow waters of bays or the inner continental shelf along the western reaches of the Deltaic Plain, longshore currents carried the fine-grained sediment west in a mudstream towards the Chenier Plain. These sediments were then brought into coastal estuaries and marshes along the gulf shoreline by tidal processes and storms which were deposited along the shore to form mudflats (Gagliano and van Beek 1970). This newly formed land was colonized by wetland vegetation, which further promoted the land-building process. Wave action and occasional storm events also deposited sand and shells onto the newly built land.

Alteration of the Mississippi River for navigation and flood control now limits the delivery of sediments onto the continental shelf and, thus, the redistribution of those sediments westward through littoral processes., with wide-ranging secondary effects. However, since 1973, delta-building processes at the mouth of the Atchafalaya River have initiated a new interval of land building via the formation of extensive mudflats along the eastern part of the Chenier Plain.

4.1.5 Mineral and Sediment Extraction

The production, refinement, and transport of oil and gas have resulted in both short- and long-term negative environmental impacts to coastal Louisiana. Recent findings have indicated that oil and gas fluid withdrawal has resulted in regional subsidence and fault reactivation causing wetland losses in coastal Louisiana (Morton et al. 2005). This induced subsidence coupled with sea level rise can lead to elevation changes, increased flooding, and eventual habitat switching and loss.

Secondary impacts result from canal construction for oil and gas extraction and the subsequent associated spoil banks which have altered the hydrology of the area (Jones et al. 2002). These barriers limit the exchange of water sediment, nutrients between the water pathways and the marsh. Hydrologic barriers such as roads, levee, and culverts obstruct the flow of water and can modify inundation patterns on either side of the barrier (Harvey et al. 2010).

4.2 Ecological Stressors

ES1: Increased Flood Duration

ES2: Storm Surge

ES3: Saltwater/Salinity

ES4: Shoreline Erosion

ES5: Marsh fragmentation.

ES6: Increased Tidal Prism or Amplitude.

ES7: Altered Circulation

4.2.1 Increased Flood Duration

Hydrologic modifications in the project area, especially the construction of roads, levees, and other similar features has altered normal drainage patterns. This had led to a condition whereby flood durations are increased in many wetland areas. This is especially problematic in the wake of a hurricane, when highly saline storm surge waters are impounded for long periods, causing stress and eventual loss of the affected wetland communities.

4.2.2 Storm Surge

Tropical cyclone events exert a stochastic but severe stress upon the swamp habitat through salinity spikes associated with saline storm surge events. The introduction of saline storm surge water into impounded areas results in reduced biomass production and impaired health, which in turn causes increased vegetation mortality, decreased soil production and integrity, and a consequent increase in relative subsidence. Saline storm surge waters become impounded by the spoil banks, roads and levees in the area. Consequently, these periodic influxes of saline storm surge waters result in cumulative increases in salinity in impounded waters and soils in the study area. Saltwater introduction into freshwater wetlands has been demonstrated to reduce productivity for short-term periods and cause the loss of wetland vegetation altogether for longer periods of inundation.

The elevation of the storm surge within a coastal basin depends upon the meteorological parameters of the hurricane as well as the physical characteristics existing within the basin. The physical factors include the basin bathymetry, roughness of the continental shelf, configuration of the coastline, and the existence of significant natural or man-made barriers. With the loss of marsh and chenier features, storm surge can become larger at points further inland, including areas of dense development.

While the study area has periodically experienced localized flooding from excessive rainfall events, the primary cause of the flooding events has been the tidal surges from hurricanes and tropical storms. During the past eight years, the planning area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes—Lili, Rita, and Ike, which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana.

Hurricane surge also causes significant damage to wetlands. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts (Barras 2006, Howes et al. 2010).

4.2.3 Saltwater/Salinity Intrusion

Salinity levels exist along a gradient, which declines as the saltwater moves inland from the Gulf of Mexico. Distinct zones of plant communities, or vegetative habitat types, differing in salinity tolerance, exist along that gradient, with the species diversity of those zones increasing from salt to fresh environments. Saltwater intrusion changes the salinity gradient, which results in habitat changes.

The combined effects of hydrologic alterations and hurricanes in the near term as well as sea level rise and subsidence over the long term lead to saltwater intrusion into areas that would otherwise remain fresh or intermediate.

Decreased freshwater inputs and increase channelization allows tidal water to intrude farther upstream, causing significant damage to freshwater wetland systems and changing freshwater wetlands to brackish or saline marshes. This is the principle factor in the conversion of freshwater systems and in extreme cases salt intolerant vegetation cannot replaced the freshwater species before the marsh converts to open water (Mitsch and Gosslink 2000, Flynn et al. 1995).

Changes to the salinity gradient are caused by a number of factors, including: the construction of levees, man-made channels, and canals, and degraded wetland areas. Tropical storm events can introduce saltwater into fresher areas, damaging large amounts of habitat in a short period of time.

4.2.4 Shoreline Erosion

Shoreline erosion is a normal consequence of natural tidal processes, wind generated waves, and surge from storm events, but can be accelerated by marsh breakdown and stress from other factors such as saltwater intrusion, flooding, and relative sea level rise. When these natural causes are combined with man-made activities (navigation/access channels) inland areas are subjected to more dramatic tidal forces and wave action, increasing erosion.

In the past 100 years, the total barrier island area in Louisiana has declined 55percent at a rate of 155 acres per year (Williams et al. 1992), largely due to storm overwash and wave erosion. In many ways the bays and lakes and the banks of canals and streams are even more vulnerable to erosion than the barrier islands. The Louisiana coast has approximately 350 miles of sandy shoreline along its barrier islands and gulf beaches; however, there are about 30,000 miles of land-water interface along bays, lakes, canals, and streams. Most of these consist of muddy shorelines and bank lines, and virtually all are eroding. In many instances, rims of firmer soil around lakes and bays, and natural levees along streams have eroded away leaving highly organic marsh soils directly exposed to open water wave attack.

4.2.5 Increased Tidal Prism or Amplitude

Tidal currents in Louisiana are relatively small, due to the small tidal amplitude. In the absence of wind, density effects and barometric pressure gradients, these currents reach magnitudes of approximately 10 – 15 cm/s (0.3 - 0.5 ft/s). Although small in magnitude in open coastal waters, tidal currents can reach speeds of approximately 50 cm/s (1.7 ft/s) at estuary and barrier island inlets, depending on the inlet dimensions. Generally, tidal exchange between back-barrier bays and the Gulf of Mexico has increased along the delta plain since at least the 1880s due to widespread conversion of wetlands and salt marsh to open water areas.

4.2.6 Altered Circulation Patterns

Circulation of coastal waters depends on driving forces such as tides, wind, and atmospheric pressure. Along the complex Louisiana coast, circulation mechanisms go beyond these driving forces to include high rainfall; the large volume of fresh water introduced by the Mississippi and Atchafalaya Rivers; currents induced by density differences and mixing processes of these two masses of water; local shoreline and bathymetric features such as the Mississippi River mouth, barrier islands, marshes, inlets, bays, and so forth. More locally, the loss of wetlands coupled with the effects of canals, ridge gapping, and other landscape alterations can significantly alter circulatory patterns.

4.2.7 Marsh Habitat Fragmentation

Habitat fragmentation is the disruption of continuous blocks of habitat into less continuous habitat as a result of human disturbances and conversion of vegetation from one type to another. Climate change, hydrologic alterations, and diminishing sediment supply individually or combined are causes of coastal degradation and habitat fragmentation in Louisiana. These impacts are worsened by human intervention at various scales

Two components of climate change that will continue to effect ecosystem connectivity are sea level rise and the increased frequency and intensity of wind-driven storm events (Hitch and Leberg 2008). Impacts are and will continue to be exasperated by human activities that have modified water and sediment delivery from watersheds to the coastal systems. Relative sea level rise is key factor contributing to the fragmentation of

coastal marshes. Inundation, resulting from seal level rise and subsidence, cause conversion of vegetated surfaces to open water thus decreasing the amount of available wetland habitat.

Marshes of the project area provide habitat and a food source for fish and wildlife species. Marsh loss implies an imbalance between sea level and marsh accretion rates – a primary factor is a decrease in or lack of sediment supply (Blum and Roberts 2009). Additionally, dredging of channels has increased water depths thereby strengthening tidal currents, enhancing erosion, and trapping sediments that would otherwise be deposited on the marsh surfaces in deeper areas.

4.3 Ecological Effects

EE1 Wetland Loss

EE2 Decreased Primary Productivity

EE3 Habitat Conversion and Changes in Biological Community Composition

EE4 Loss of Ridges and Cheniers.

4.3.1 Wetland Loss

Wetland loss in the project area can be the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish.

The accelerated loss of Louisiana's wetlands has been ongoing since at least the early 1900s with equal harmful effects on the ecosystem and possible future negative impacts to the economy of the region and the Nation (LCA 2004).

The LCA Study (2004) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year over the next 50 years. It is estimated that an additional net loss of 328,000 acres may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands.

Wetland degradation and loss are the result of both natural factors and anthropogenic activities, producing conditions where wetland vegetation can no longer survive and wetlands are lost (Barras et al. 2003, Barras et al. 1994; Dunbar et al. 1992). Natural causes contributing to coastal land loss include: wave erosion, sea level rise, subsidence resulting from compaction of muddy and organic sediment, geologic faulting, river floods, and tropical storm events. Human activities that have impacting coastal wetland loss include: flood control modifications including the Mississippi River levee system, navigation channels and structures, oil and gas infrastructure, and direct water quality impacts.

In the project area, the process for wetland loss can start with the be the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish.

Perhaps the most serious and complex problem in the study area is the rate of land and habitat loss. The Louisiana coastal plain contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004). Across much of the Louisiana coast, wetland loss and shoreline erosion continue largely unabated, resulting in accelerated coastal land loss and ecosystem degradation.

4.3.2 Reduced Primary Productivity

Decreased productivity in vegetative communities in the study area is thought to be a biological response to the lack of nutrients and sediment inputs, and saline stress from flooding following storm surge.

There has been a reduction in frequency of nutrient and sediment rich waters into and across the wetlands as a result of flood protection and water control structures, and channelization for navigation and oil and gas infrastructure. Instead, the nutrient rich water is delivered directly into the coastal bays or into the Gulf of Mexico, and often as a result, coastal wetlands lack the required nutrients necessary to maximize productivity. Increased productivity results in higher organic soil formation, which then leads to increased deposition and vertical accretion.

Salinity induced stress decreases primary production and biomass in freshwater marshes (Smart and Barko 1980, Linthurst and Seneca 1981, Pezeshki et al. 1987, McKee and Mendelssohn 1989, Spalding and Hester 2007) and therefore organic matter and vertical accretion rates are compromised following saltwater intrusion. Maintaining a balanced position in the coastal landscape requires that marshes accrete vertically as sea level rises and the marsh surface sinks because of subsidence. In coastal Louisiana, the amount of sedimentation required to keep pace with sea level rise is high compared to regions of the United States (Stevenson et al. 1986).

4.3.3 Habitat Conversion and Changes in Biological Community Composition

Habitat conversion can be the result of several drivers acting independently or collectively. The conversion of habitat can make an area more susceptible to storms and erosion as well as altering the type of fauna expected to occur in the area. Freshwater marsh can be susceptible to saltwater intrusion. The effects of invasive species can damage or displace native vegetation.

Coastal marshes also provide habitat for a variety of vertebrate wildlife including fish, birds, mammals, and reptiles. Teal (1986) stated that one of the most important functions of coastal marshes was to provide habitat for migrant and resident bird populations. Some wildlife species inhabiting tidal marshes are also important game animals, valuable furbearers, and provide recreational opportunities for birdwatchers, nature enthusiasts, and wildlife photographers (USACE 2010).

The majority of species that utilize the wetlands have neither commercial nor recreational value, but simply are ecologically important members of the ecosystem. Many of the organisms that use the marsh ecosystem are highly mobile and serve as a transfer mechanism for nutrients and energy to adjacent terrestrial or aquatic ecosystems. Some of the larger vertebrates, including the muskrat and nutria, consume large amounts of forage and, at high densities, can have significant impacts on marsh vegetation structure (USACE 2008).
Tidal marshes provide forage habitat, spawning sites, a predation refuge, and a nursery for resident and nonresident fishes and macrocrustaceans. These organisms use tidal marshes or adjacent subtidal shallows either year round or during a portion of their life history. These organisms are consumed by nektonic and avian predators and are considered to represent an important link in the marsh-estuarine trophic dynamics (USACE 2008).

4.3.5 Loss of Ridges and Cheniers

The Chenier Plain of SW Louisiana consists of multiple shore-parallel, sand rich ridges that are balanced on and physically separated from one another by relatively finer grain, clay-rish sediments. Cheniers are unique and critical components of the local environment. They support a diversity of wildlife and, because of their location along important migration pathways, are especially significant for migrating birds, as well as providing natural protection against salt water intrusion, storm surge, and flooding (Providence Engineering Group Cheniers and Natural Ridges Study 2009).

Formed over thousands of years by the deltaic processes of the Mississippi River and other streams, the chenier ridges of southwest Louisiana run laterally to the modern shoreline and rise above the surrounding marshes by as little as a few inches or as much as 10 ft (Gould and McFarlan 1959, Byrne et al. 1959). These ridges range from 2 to 15 ft thick and from 100 to 1,500 ft wide, with some ridges extending along the coast

for a distance of up to 30 miles. Live oak and hackberry are dominate canopy species, and others common species are red maple, sweet gum, water oak, green ash, and American elm.
Cheniers have been severely impacted by human activities such as deforestation for conversion to cattle pasture or development. They have also been threaten by coastal erosion and wetland loss resulting from salt water intrusion, subsidence, hurricanes, debris from oil and gas infrastructure by storms, navigation channels, and invasive species.

4.4 Attributes and Performance Measures

A1 Land Cover/ Land Change

Performance Measures: Relative Change in Land Cover

A2 Vegetation Distribution and Diversity

Performance Measures: Community Composition and Relative Abundance

A3 Elevation

Performance Measures: Surface Elevation and Vertical Sediment Accretion

4.4.1 Land Cover

Land cover has been identified as a key indicator of project success with respect to preventing habitat conversion and future land loss. Comparison of pre-project land cover characteristics with post-project land cover characteristics would serve to determine if the current trend in habitat conversion and land loss within the study area experiences a post-project decline or ceases altogether. Additionally, post-project land cover analysis would determine if areas within the study area that had previously gone through a conversion, undergo a post-project reversion.
Spatial analysis has been identified as an assessment performance measure for the determination of the response of land cover to the proposed project. Spatial analysis may involve comparative analysis of pre-project and post-project aerial or satellite imagery and may utilize Landsat Thematic Mapper analysis to determine relative changes in land cover within the study area.

4.4.2 Vegetation Distribution and Diversity

Plant distribution and diversity has been identified as a key indicator of project success with respect to preventing, reducing, or reversing wetland loss in the study area. Comparison of pre-project vegetation monitoring data with post-project vegetation monitoring data would serve to determine if plant communities within the study area change in response to project features.

Relative abundance is a measure of the abundance or dominance of each species present in a sample. Relative abundance can be used to document the degree of impact in an area by measuring both species dominance and evenness. Relative abundance can be used to assess ecosystem health by comparing plant density before and after project implementation. The Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) as described in Steyer et al. (1995) will be utilized to measure relative abundance.

A post-project stabilization of relative abundance within the study area would be an indication of significant project success, while a post-project reduction in the rate of decline of relative abundance would be an indication of moderate project success. Conversely, no change in the rate of decline of relative abundance post-project would indicate that the project did not succeed in increasing vegetation productivity.

4.4.3 Elevation

Ground surface elevation has been identified as a key indicator of project success with respect to increasing sediment and nutrient load within the study area. Comparison of pre-project elevations with post-project elevations would serve to determine if sediment input and soil accretion is occurring within the study area in response to project features. A post-project decrease in the rate of elevation decline would implicitly indicate the introduction of nutrients and sediment into the marshes as a result of the project. Two performance

measures have been identified for this attribute, including surface elevation table (SET) measurements and feldspar marker horizon measurements.

Surface Elevation Table (SET) measurements provide a constant reference plane in space from which the distance to the sediment surface can be measured by means of pins lowered to the sediment surface. Repeated measurements of elevation can be made with high precision because the orientation of the table in space remains fixed for each sampling. Elevation change measured by the SET is influenced by both surface and subsurface processes occurring within the soil profile.

Feldspar marker horizon measurements involve the placement of a cohesive layer of feldspar clay on the ground surface. Soil borings are extracted at the marker horizon location periodically to measure the amount of soil deposition and/or accretion that has occurred above the horizon since placement. Significant quantities of soil atop marker horizons are indicative of soil building within the area, which in turn indicates an increase in relative elevation. A post-project stabilization of elevation as evidenced by SET measurements or documented soil accretion atop a marker horizon within the study area would be an indication of significant project success, while a post-project decrease in the rate of decline in elevation would be an indication of moderate project success. Conversely, no change in the rate of elevation decline post-project within the study area would indicate that the project did not succeed in offsetting subsidence and, by extension, habitat conversion and future land loss.

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